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User Guide for Ilum 1 Road Lighting Design Program

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Abstract:
This report documents recent modifications of the ILUM1 computer program and provides an outline of the basic illumination concepts and principles upon which the program is based. The detailed structure of the program is described in terms of its individual components and the program is listed. Also included is a user's manual with worked examples.

Key Words: Illumination, Lighting Design, Luminance Method, Roadway Lighting, Highway Lighting, Fixed Lighting of Roadways

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PREFACE

The purpose of this report is to document recent modifications of the ILUM1 computer program and provide an outline of basic illumination principles and concepts which the program was based upon.

The report also contains the detailed structure of the program in terms of its individual components, a user's manual with examples and the listing of the program.

DISCLAIMER

Although all available programs have been subjected to many rigorous tests — no warranty, expressed or implied, is made by the Ministry as to the accuracy and functioning of the programs, nor shall the fact of distribution constitute any such warranty, and no responsibility is assumed by the Ministry in any connection therewith.

ABSTRACT

In 1981, the Illuminating Engineering Society of North America (IESNA) recommended revisions to the standard practices for calculation and measurement of illuminance and luminance values.

These recommendations proposed that illuminance and luminance values be calculated for points located along lines 1/4 roadway lane width from the edge of each lane (two lines of points for each lane).

The existing computer program for the design of highway lighting (ILUM1) could not accomodate the IES proposals and therefore required modification.

The revised ILUM1 is very complex because it has been structured to accomodate both the original and the revised data formats, combined with the implicit utilisation of luminaire photometrics and pavement characteristic variables. Therefore it was necessary to expand this report beyond the immediate ILUM1 modifications to include the following topics:

- general lighting principles and their rationale,
- program framework and component functions,
- input structure and functions,
- luminaire description and photometric data,
- pavement classifications and reflectivity parameters,
- examples of lighting design and graphic representation,
- examples of JCL requirement, and
- program listing.

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1/ ILLUMINATION CONCEPTS

1.1/ Background

Prior to 1977, the North American Standard Practices for roadway lighting had been based only on the illumination considerations as the main criteria of roadway lighting design.

However, it has long been recognized that the reflectance characteristics of the roadway surface, in the direction of the observer determines the brightness pattern of the roadway. This brightness pattern, which is refered to as luminance of the roadway surfaces, has been identified as the best indicator of visual appearance of the roadway from the observer's point of view.

The other parameter which affects roadway visibility is the glare from the roadway lighting, this is refered to as veiling brightness.

The inclusion of these additional parameters in the assessment of roadway visibility was a forward step towards a more meaningful identification of quality and quantity considerations for roadway lighting.

Consequently, in 1977 the Illuminating Engineering Society of North America (IESNA) expanded the roadway-lighting design methods to include illumination measures, roadway luminance and veiling brightness as criteria of lighting design.

1.2/ Parameters of Roadway Visibility

Luminance has been identified and accepted as the basic physical parameter which must be applied for the quantification of visual perception of the roadway surface. The reaction of an observer's visual system to the physical quantity of luminance results in a subjective response termed as "brightness". This brightness sensation is related to the external luminance. However, since there is no directional proportionality between the stimulae and response, because of many nonlinear linkages in the human perception system, the roadway lighting criteria are based on a man-machine-environment system with both objective (physical) and subjective (human response) attributes. Thus, both "qualitative" and "quantitative" measures are necessary in the specification of roadway lighting criteria. The qualitative measures are expressed by means of uniformity of roadway luminance and illuminance as well as the relative freedom from glare. The quantitative measures are established by the average values of luminance and illuminance on the roadway.

The prime measure generally should be the roadway luminance because this is the parameter that affects visual perception. However, there may arise unique situations when the design procedure for luminance will indicate a satisfactory pattern yet the actual installation of luminaires may not yield satisfactory results. Such deficiency may arise because the luminance calculation procedure implicitly assumes that the observer is always at a fixed location and the roadway is represented by one of the standarized reflection factors tables -- neither of which is entirely true. Hence, in order to overcome the occurrence of such deficiencies, it is necessary to evaluate the density of visible energy (i.e., illuminance) distributed along the roadway as a supplementary evaluation. The rationale of this test is to provide the practitioner of highway lighting with specifications which require the assessment of known quantities. Another factor that must be specified in the design of roadway lighting systems is the degree of glare that will be permitted from the roadway lighting luminaires. The effects of a high brightness source in the field of view causes a reduction in the ability to see objects, creates discomfort and fatigue, and causes erratic and annoying responses -- all of which contribute to hazardous situations on the roadway.

The following are the outlines of the basic principles used for the calculation of the roadway lighting parameters.

1.2.1/ Luminance

The reflecting properties of a roadway surface depend on the surface texture and its composition. The ability of these properties to reflect illumination is defined as luminance.

Figure 1 shows a roadway section illuminated by one luminaire as it would be viewed by an observer.

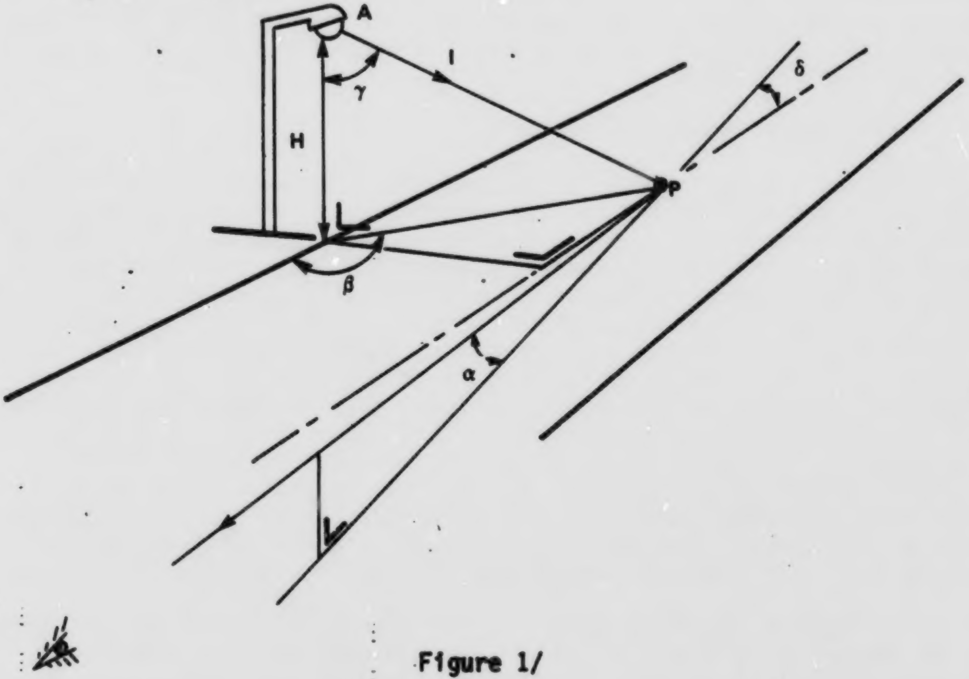


Figure 1/

where:

I = luminous intensity of the luminaire towards point P
A = position of luminaire
H = luminaire height
P = point of observation
O = observer position
γ = angle of incidence
β = angle between vertical plane of incidence and roadway
α = angle of observation between the plane and height of the observer
δ = angle between directions of observation and direction of roadway

Because the luminance coefficient is a directional proportionality constant, the basic luminance equation can be expressed as:

$$L = q\,E \qquad (1)$$

where: L = luminance at point P in the 0 direction cd/m^2
E = illuminance at point P (lumens/m^2)
q = directional proportionality constant generally termed luminance coefficient

However, since the luminance coefficient 'q' is dependent on the position of the light source and the relative position of the observer, the magnitude of 'q' is dependant on the particular values of α, β, γ and δ, as shown in Figure 1.

The basic luminance equation (1) can be expressed as follows:

$$Lp = q(\alpha, \beta, \gamma, \delta)\ Ep \qquad (2)$$

From the first principles of illumination, using both the inverse square law and the cosine law, the illumination at point 'P', Figure 1, can be expressed by Equation 3.

$$Ep = \frac{I_A}{(AP)^2} \times \cos\gamma \qquad (3)$$

but $(AP)^2 = \dfrac{H^2}{\cos^2\gamma}$

then $$Ep = \frac{I_A}{H^2}\cos^3\gamma \qquad (4)$$

Substituting (4) into (2),

$$Lp = q(\alpha, \beta, \gamma, \delta) \cdot \frac{I_A}{H^2}\cos^3\gamma \qquad (5)$$

From Equation 5 it is evident that the variables 'q' and $\cos^3\gamma$ can be combined into one value. This value (which is designated by "r") is termed the reduced luminance coefficient and defines the measure of reflection properties of the roadway surface. The magnitude of 'r' is expressed by Equation 5a.

$$r(\alpha, \beta, \gamma, \delta) = q(\alpha, \beta, \gamma, \delta) \cdot \cos^3\gamma \qquad (5a)$$

In the measurements of the reduced luminance coefficent matrices and in the classification of pavements, the viewing angle 'α' is set to 1°. This angle corresponds to the most critical viewing distance of a car driver, namely 80 to 100 m ahead of his current position. It is also assumed that the influence of δ is negligible and can be accepted as $\delta = 0$. Consequently, Equation 5a should be expressed as follows:

$$r(\beta, \delta) = q(\beta, \gamma) \cdot \cos^3\delta \qquad (5b)$$

Substituting Equation 5b into (5), the basic luminance equation can then be expressed in the following terms:

$$Lp = r(\beta,\gamma) \cdot \frac{I_A}{H^2} \cdot \cos^3\gamma \qquad (6)$$

The luminous intensity of a luminaire is not uniformly distributed in all directions. The directional luminous intensity for each luminaire type is specified as part of the photometric data in terms of angles ϕ and γ' as shown in Figure 2.

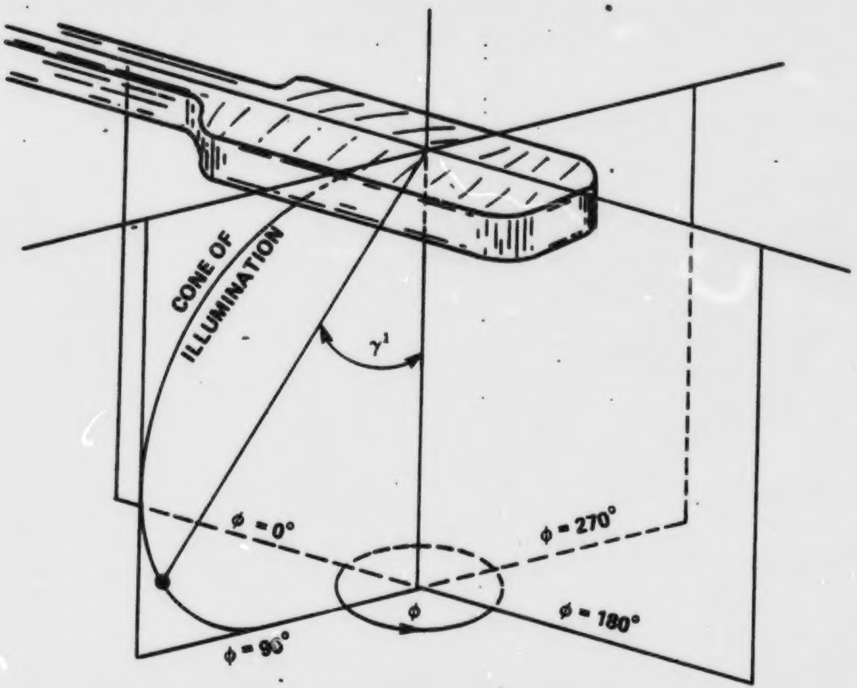


Figure 2/

The ϕ and γ' co-ordinate system is defined with reference to the luminaire itself, and since the luminaire can be mounted with some slant to the roadway, the angles ϕ and γ' do not refer to a fixed direction in space, but must take into consideration the slant angle when directional intensity is determined. For this reason, angle γ' was designated to distinquish it from angle γ used in the designation of reduced luminance coefficients.

Hence, the luminous intensity equation is expressed in the following terms:

$$L_p = r(\beta,\gamma) \cdot \frac{I_A}{H^2}(\phi,\gamma') \cdot \cos^3\gamma \qquad (7)$$

Both the 'I' (luminous intensity) and the 'r' (reduced luminance coefficent) tables are stored in the ILUM1 data bank on files 11 and 12, respectively.

It must be pointed out that the matrices of both the 'r' and 'I' tables are stored in the data bank in terms of angular co-ordinates.

However, the roadway grid pattern (along which the luminance, illuminance and disability veiling brightness are calculated) is expressed in rectangular (x,y) co-ordinates.

Consequently, prior to the selection of appropriate 'r' and 'I' table values from the data bank, the roadway rectangular co-ordinates require transformation into an angular co-ordinates system.

The following are the transformation equations derived from Figure 3.

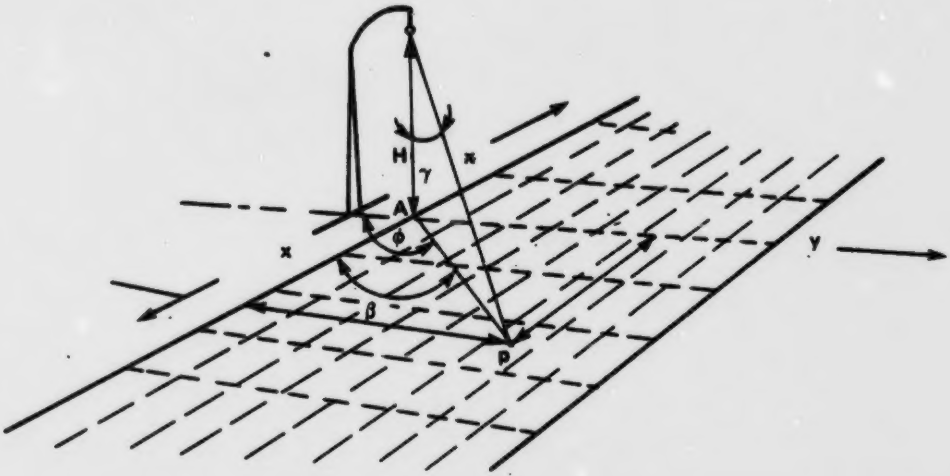


Figure 3/

Where: $AP = H \tan \gamma$ $\qquad AP = \sqrt{x^2 + y^2}$

$x = H \tan \gamma \cos \beta$

$y = H \tan \gamma \sin \beta$

$$\gamma = \text{arc tan} \frac{\sqrt{x^2 + y^2}}{H}$$

$$\phi \ \& \ \beta = \text{arc tan} \frac{y}{x}$$

1.2.2/ Illuminances

The equations traditionally used for the calculation of illuminance have been derived from the relationships shown in Figure 4.

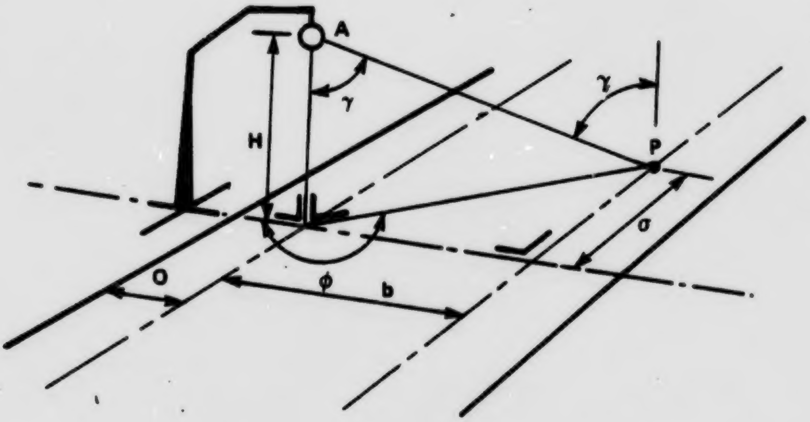


Figure 4/

where: I = luminous intensity of luminaire at 'A'
H = luminaire height
E_p = illuminance at P in lumens

$$E_p = \frac{I_A}{(AP)^2} \cdot \cos\gamma \qquad \text{but } (AP)^2 = \frac{H^2}{\cos^2\gamma}$$

then $$E_p = \frac{I_A}{H^2} \cdot \cos^3\gamma \qquad (8)$$

Taking into consideration the directional intensity shown in Figure 2, Equation 8 will be expressed as follows:

$$E_p = \frac{I}{H^2}(\phi, \gamma') \cdot \cos^3\gamma \qquad (9)$$

1.2.3/ Disability Veiling Brightness

The equations used to calculate disability veiling brightness have been derived from the relationships illustrated in Figure 5.

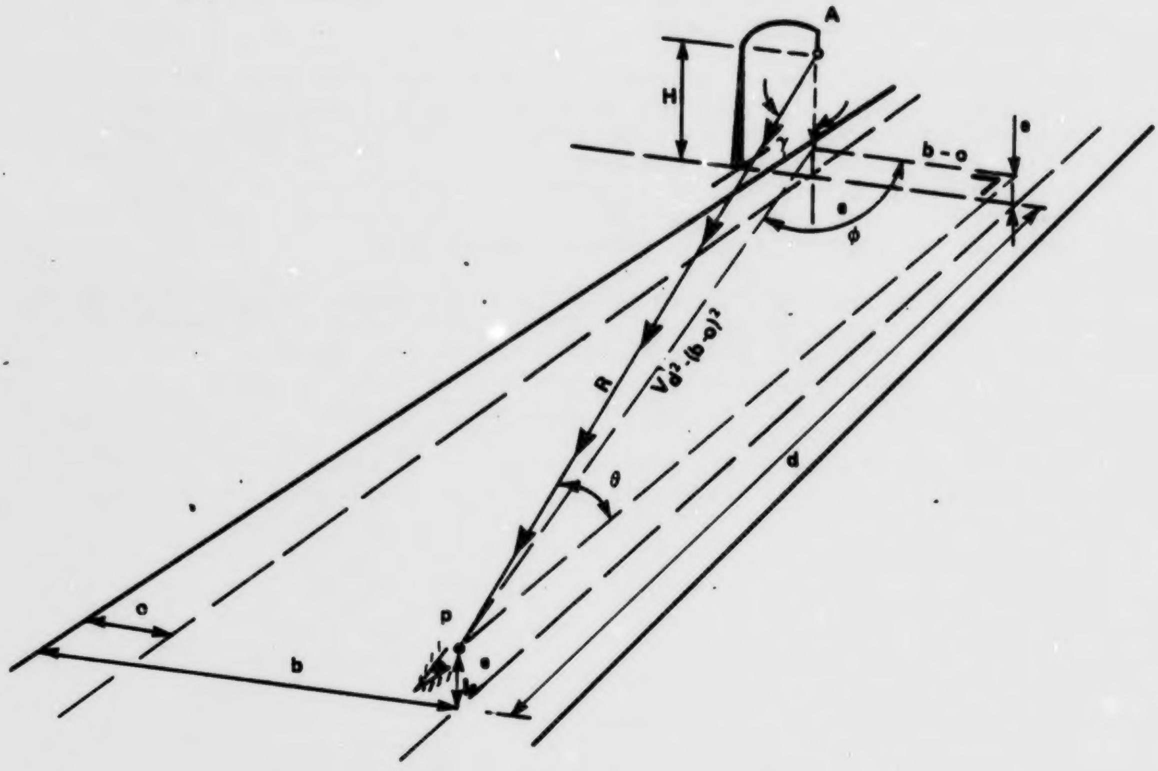


Figure 5/

Where: $\theta = \text{arc tan } \frac{\sqrt{(h-e)^2 + (b-o)^2}}{d}$

$\phi = \text{arc tan } \frac{d}{b-o}$

$\gamma = \text{arc tan } \frac{\sqrt{d^2 + (b-o)^2}}{h - e}$

$R = \frac{h - e}{\cos \gamma}$

$E_p = \frac{I\ (\phi, \gamma) \cos \theta}{R^2}$

$DVB = \frac{10\ \pi\ Ep}{\theta^2}$ (in foot lamberts) (10)

$DVB = \frac{10\ Ep}{\theta^2}$ (in candelas/m^2) (11)

2/ ILUM1 -- USER INSTRUCTION GUIDE

2.1/ Purpose and Program Outline

The ILUM1 computer program was originally developed in 1977 for the purpose of designing and evaluating fixed highway lighting systems in accordance with IES requirements.

The program calculates, illuminance, luminance and disability veiling brightness, based on a specified set of parameters such as roadway geometrics, luminaire photometrics and patterns, and the reflectivity properties of pavement texture. The program can generate the aforementioned design parameters in a hard copy output in a tabular format. Also, a supplementary plot program can generate iso-line plots of illuminance and luminance for specific roadway sections (Appendix B).

The ILUM1 program is written in the FORTRAN G1 computer language with the source consisting of approximately 1000 cards in length. The program makes use of an 80-column card reader, areas on disk and drum for direct access of light intensity distribution (I) tables and luminance coefficient (r) tables, and tape if plotting is required.

ILUM1 requires approximately 200K bytes of central memory on an IBM 370 and consists of 15 routines whose logical interrelationship is shown in Figure 6.

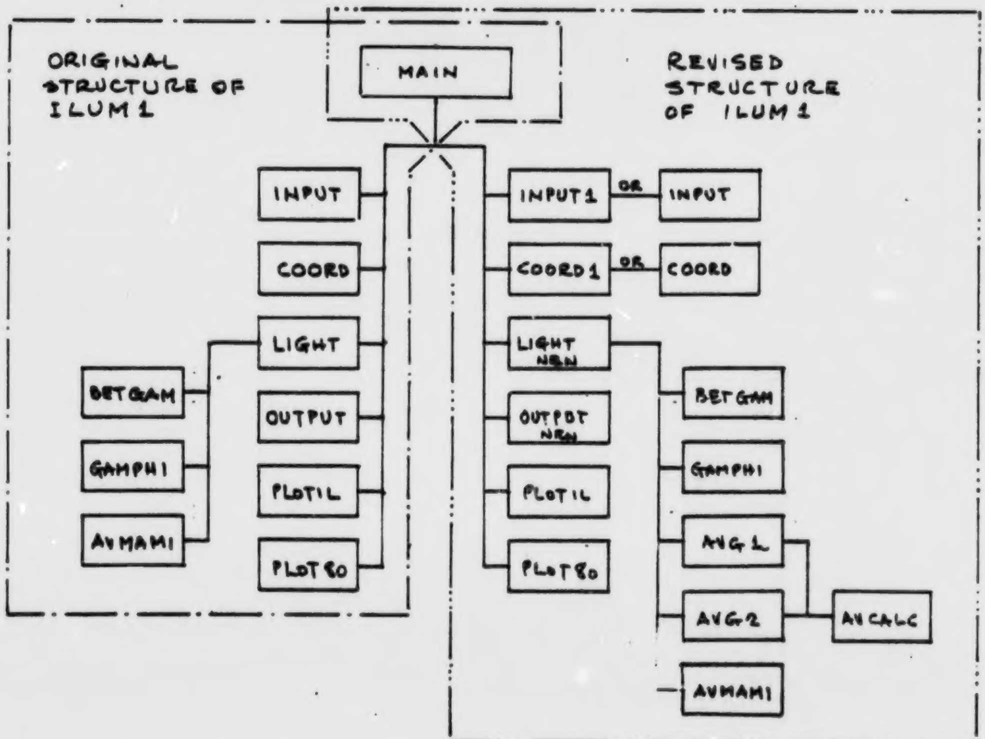


Figure 6/ Routine Interrelationship Logic of Original and Revised ILUM1 Program

The original ILUM1 program sets up the roadway grid patterns along the edges of pavement as well as edges of lanes and strips within each lane. However, the revised ILUM1 constructs a grid pattern along lines 1/4 lane width from the edge of each lane (see grid pattern, Section 2.3, Program Options).

The primary function of the MAIN routine is to control the overall execution of the program. This routine reads the input data, identifies which program version is to be used, and then calls up appropriate subroutines for execution. A trace option has been added for the purpose of debugging the program. Its main function is to set up and keep track of the key calculation steps.

INPUT and INPUT1 subroutines both perform similar functions, for the original and revised version of the program, of reading, editing and reprinting the input data and error messages.

COORD and COORD1 subroutines calculate the grid patterns along the surface of the roadway, shoulders and median. It also calculates the grid co-ordinates of each luminaire and relative position of the driver 90 m in front of each grid point at the centre of each lane. The COORD subroutine is called up by the original ILUM1 while COORD1 is called up for the revised version.

The LIGHT subroutine calculates illuminance, luminance for every grid point of the designated roadway area and disability veiling brightness for each driver position. This subroutine also calls up other subroutines BETGAM, GAMPHI, AUG1, AUG2, AUCALC and AUMAMI to perform such functions as interpolation of data bank photometric values and reduced luminance coefficients, and calculation of average design parameters and uniformity ratios for each lane.

The PLOT80 subroutine stores the illuminance and luminance data on an external file which is used as input for a plotting program to create a plot tape for plotting this information graphically.

The PLOTIL subroutine stores illuminance data only on an external file for further processing and plotting of these data graphically.

2.2/ Input Assumptions and Limitations

1/ The maximum number of roadway lanes in either direction is four.

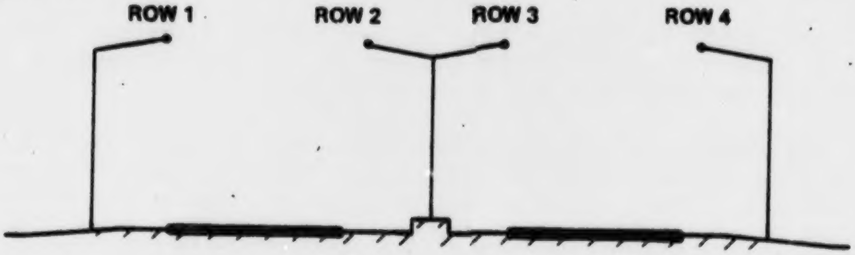
2/ The maximum number of divisions between two luminaires in the same row cannot be more than 90. The newly-added revision specifies also that the maximum distance (i.e., division length) between each strip should not be greater than 5 m (16.5 ft).

3/ The disability veiling brightness angle is limited to a maximum value of 30° 00' 00". The default value of this angle is set to 20° 00' 00".

4/ The maximum number of luminaires in front of and/or behind the study area which will be considered as a source of illumination is limited to 12. The minimum number of luminaires is three in front or back of the study area.

5/ In the calculation of luminance, it is assumed that the driver of a vehicle looking ahead scans the area at a fixed distance in front of him. This distance is assumed to be 90 m (300 ft). Thus, the calculations are carried out for all the points on a perpendicular line across the pavement at a constant distance ahead of the driver. Moving ahead in this manner, it is assumed that the driver maintains a constant viewing angle of approximately 1°.

6/ The luminaire installation can consist from one to four rows with each row having its own mounting insight and staggered position. The four rows of luminaires can be arranged into six patterns as shown in Figure 7.



PATTERN ARRANGEMENT*

Row 1 or Row 4 -- Pattern 1
Row 1 and Row 4 -- Pattern 2
Row 2 and Row 3 -- Pattern 3
Row 1 + Row 2 + Row 3 + Row 4 -- Pattern 4
Row 1 + Row 2 + Row 3 -- Pattern 5
Row 2 + Row 3 + Row 4 -- Pattern 6

Figure 7/
(* Note: Staggering does not effect the pattern selection.)

7/ Luminaire orientation is assumed to be "TRUE & RIGHT". This means that the position of the luminaire in relationship to the roadway is at right angles to the direction of travel and that the luminaire is not slanted at an angle to the plane of the roadway.

8/ The design parameters can be calculated for the sections of roadway which are straight and cross-fall and/or superelevation of the pavement are not considered in this calculation procedure.

9/ The maximum width of pavement should consist of two roadways of four lanes each, two shoulders, and one median (the median can be considered as inside shoulders).

10/ The spacing between luminaires of each row is the same. The shift or stagger for each row is individually selected.

2.3/ Program Options

ILUM1 provides choice of the following options:

1/ Grid Pattern -- It has been observed that some factors previously expected to have negligible influence upon the computed luminance pattern could, in fact, cause a significant discrepancy in the final results. Selection of an appropriate grid size pattern is one such factor. If too coarse a grid is selected for computation, the true minimum and maximum luminance values, which are employed for the evaluation of luminance characteristics, can fall between the grid points. On the other hand, a very fine grid can result in large numbers of 'r' and 'I' table interpolations as well as a multitude of computations, resulting in costly and cumbersome-to-analyse outputs.

The American National Standards Practice in Roadway Lighting published by IES recommends that the number of grid points between two consecutive luminaires should not be less than 10 and that the points should be spaced not more than 5 m apart.

Across the roadway width, the spacing of grid points depends on the number of strips selected for the division of shoulders and lanes. There are two options available for the selection of grid type across the roadway:

Version 1 is the originally developed version of ILUM1 placed which places the grid points along the lines delineating each strip and pavement type as shown in Figure 8a.

Version 2 (revised ILUM1) is the method based on the 1981 IES recommendations which places the grid points along the lines 1/4 lane width from each edge of each lane as shown in Figure 8b.

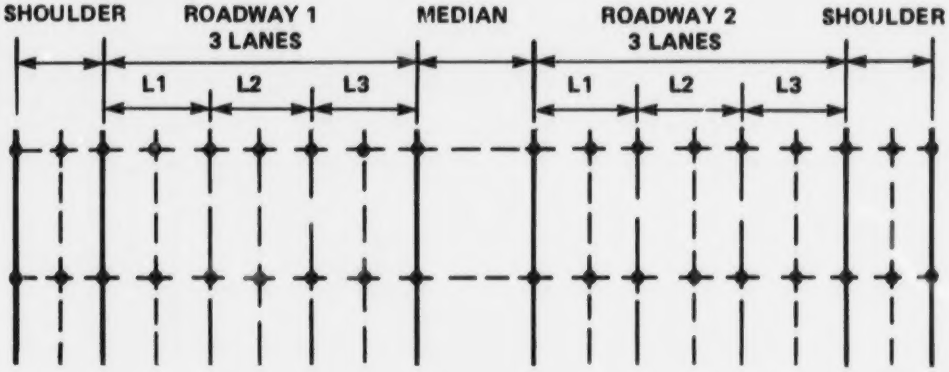


Figure 8a

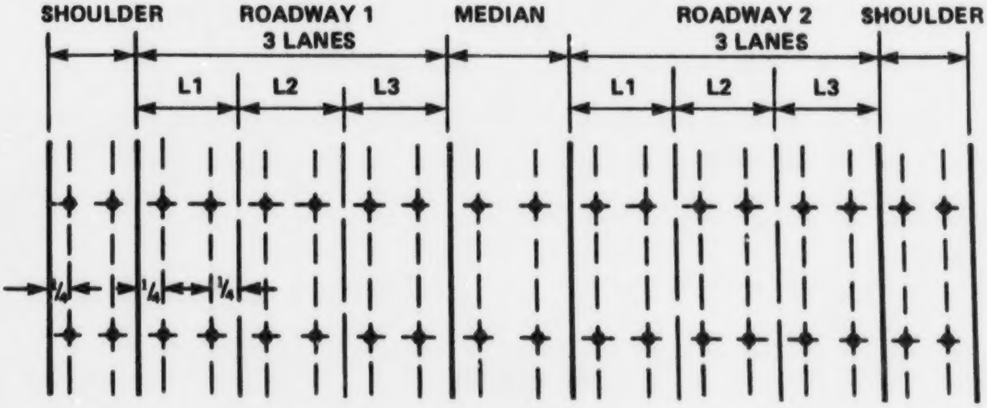


Figure 8b

2/ The lanes, shoulders, and median can be subdivided into either two- or four-strip sections for the development of the grid pattern.

3/ Iso-illuminance and iso-luminance plots can be generated by including the additional job step of calling up the "CONTOUR" program from the library "TCEC.ECSPMAC". The required JCL statements are illustrated in Appendix A.

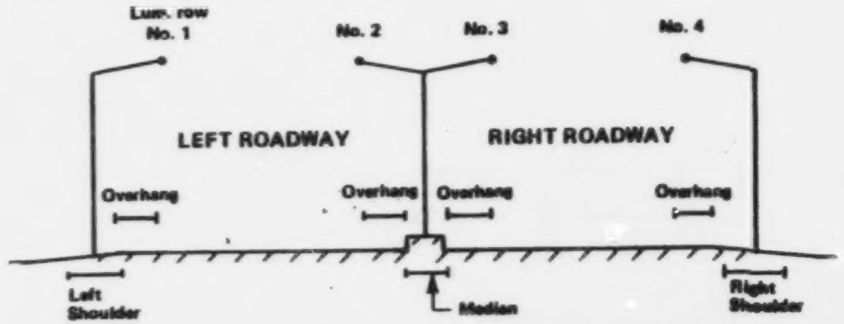
4/ The luminance (calculation and plotting) portions can be suppressed or by-passed when a proper code is invoked (B=1).

5/ The outputs can be calculated in either imperial or metric units.

6/ Traffic flow can be shown in either direction. The left-hand roadway flow is assumed to be towards the observer and the right-hand roadway flow is away from the observer. When one-way traffic flow is considered, the roadway having inappropriate direction is omitted from input.

LUMINAIRE PATTERN

Pattern		
1	Rows	1 or 4
2	Rows	1 + 4
3	Rows	2 + 3
4	Rows	1 + 2 + 3 + 4
5	Rows	1 + 2 + 3
6	Rows	2 + 3 + 4



N.B.

1. Mounting height is from pavement to luminaire
2. Overhang is distance from edge of pavement to luminaire, + ve direction as shown
3. First luminaire position in each row defines relative position of the four rows of luminaires along the road.

UNIT	Enter 'F' for imperial, 'M' or leave blank for metric
L_1, L_2	No. of lanes on left and right roadway respectively $L_1 > 0$, $L_2 \geq 0$
S_1, S_2	No. of strips on left and right shoulder respectively S_1 or $S_2 \leq 2$
N	No. of strips/lane N = 4 or 2
NK	No. of strips/lamp pole interval NK ≤ 90
NL	No. of lamp pole intervals in front of and in rear of area under study
Qφ	Average luminance coefficient in metric system
A	Enter 1 if one way traffic, otherwise, leave blank
B	Output code from 1 to 4
C	Enter 1 if divided highway
D	Enter 1 if road slopes up in direction of traffic flow on right roadway Enter O if road slopes down in direction of traffic flow on right roadway or if no slope
EPSLN	Angle of the road's slope.

1	80
TITLE	

ROAD DATA

1	3	6	9	13	15	17	22	27	32	34	36	41		44	46			52		58			61
	unit	pavement type		S_1	L_1	left rdway width	median width	right rdway width	L_2	S_2	distance bet'n 2 Lum	N	NK	NL	O.V.H. angle D	M	S	Qφ	A	B	C	D	EPSLN
C						.	.	.			.							.					.

LUMINAIRE DATA

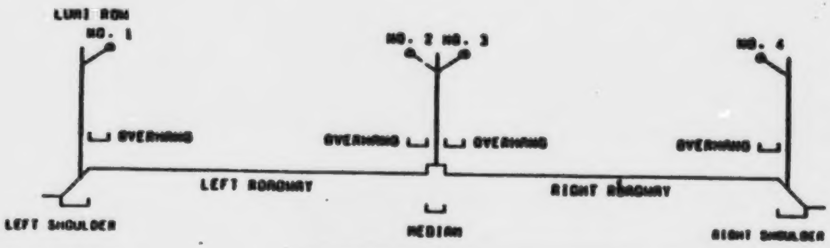
1	3	5	9	14	18	24	28	33	37	43	47	52	56	62	66	71	75	80
	pattern	type	mounting height	overhang	first lumin. position	type	mounting height	overhang	first lumin. position	type	mounting height	overhang	first lumin. position	type	mounting height	overhang	first lumin position	
L		1	.	.	+ .	2	.	.	+ .	3	.	.	+ .	4	.	.	+ .	

1	3	7	11	15	19	23	27	31
	maintenance factors (1)	(2)	(3)	(4)	prorating factors (1)	(2)	(3)	(4)
F	.	.	.	.	.	.	.	.

Figure 9a/

LUMINAIRE PATTERN:

PATTERN 1 : ROWS 1 OR 4
2 : ROWS 1 + 4
3 : ROWS 2 + 3
4 : ROWS 1 + 2 + 3 + 4
5 : ROWS 1 + 2 + 3
6 : ROWS 2 + 3 + 4



LEGEND

U : ENTER "F" FOR IMPERIAL, "M" OR LEAVE BLANK FOR METRIC
L1,L2: NUMBER OF LANES ON LEFT AND RIGHT ROADWAY RESPECTIVELY L1>0,L2>=0
S1,S2: NUMBER OF STRIPS ON LEFT AND RIGHT SHOULDER RESPECTIVELY S1 OR S2<=2
N : NUMBER OF STRIPS PER LANE N=2 OR N=4
NK : NUMBER OF STRIPS PER LAMP POLE INTERVAL NK<=90
NL : NUMBER OF LAMP POLE INTERVALS IN FRONT OF AND IN REAR OF AREA UNDER STUDY
QO : AVERAGE LUMINANCE COEFFICIENT IN METRIC SYSTEM
A : ENTER 1 IF ONE WAY TRAFFIC, OTHERWISE LEAVE BLANK
B : ENTER 1 FOR NO LUMINANCE OUTPUT, OTHERWISE LEAVE BLANK
C : ENTER 1 IF DIVIDED HIGHWAY
M : NUMBER OF STRIPS PER MEDIAN
DISTP: DISTANCE BETWEEN LUMINAIRES
IC : ICURVE

N.B.
1. MOUNTING HEIGHT IS FROM PAVEMENT TO LUMINAIRE.
2. OVERHANG IS DISTANCE FROM EDGE OF PAVEMENT TO LUMINAIRE, POSITIVE DIRECTION AS SHOWN.
3. FIRST LUMINAIRE POSITION IN EACH ROW DEFINES RELATIVE POSITION OF THE FOUR ROWS OF LUMINAIRES ALONG THE ROAD.

1	5	80
	TITLE	
IES		

ROAD DATA

1	2	3	6	7	8	12	16	20	24	28	32	36	40	44	48	52			55	57	59				64	68			74	80
	U	PAVE TYPE	S1	L1	WIDTH OF LEFT SHOULDER	L.H.S. LANE WIDTHS (1)	(2)	(3)	(4)	MEDIAN WIDTH	R.H.S. LANE WIDTHS (1)	(2)	(3)	(4)	WIDTH OF RIGHT SHOULDER	L2	S2	N	NK	NL	M	A	B	C		D.V.B. ANGLE D	M	S	QO	
C																														

LUMINAIRE DATA

1	3	5	6	8	14	18	24		29	33	37	43		47	52	56	62		66	71	75
	PATTERN		TYPE	MOUNTING HEIGHT	OVERHANG	FIRST LUMIN. POSITION		TYPE	MOUNTING HEIGHT	OVERHANG	FIRST LUMIN. POSITION		TYPE	MOUNTING HEIGHT	OVERHANG	FIRST LUMIN. POSITION		TYPE	MOUNTING HEIGHT	OVERHANG	FIRST LUMIN. POSITION
L		1				+	2				+	3				+	4				+

1	2	6	10	14	18	22	26	30	34	39	40	46
	MAINTENANCE FACTORS (1)	(2)	(3)	(4)	PRORATING FACTORS (1)	(2)	(3)	(4)	DISTP	E	RADIUS	IC
F												

Figure 9b/

2.4/ Input Formats

The input formats of the origianl and the revised versions of ILUM1 are shown on the coding sheets presented in Figures 9a and 9b, respectively. Both of the coding sheets consist of four cards, 80 fields in length.

2.4.1/ Input Format of the Revised Version of ILUM1

CARD 1 contains the "IES" designation in fields 1 to 4 which determines the method for calculation of the grid pattern and the calling up of appropriate subroutines. Fields 5 to 80 on this card are used for labelling the job with an appropriate title (if so desired).

1 4	5 80
IES	

NOTE: -- The "IES" designation must be present on the first card as shown above to invoke the revised version of ILUM1.

To initiate a trace put a TRACE card immediately after the title card. To bypass the trace option, omit the TRACE card altogether.

TRACE Card Format

1	2	3	4	5	6	7	8	9	10
T	R	A	C	E		T	T	T	

'TRACE' in fields 1 to 5
'T' in field 7 generates trace in subroutines INPUT, INPUT1, COORD, COORD1, AUG1 and AUMAMI
'T' in field 8 generates trace in LIGHT subroutine
'T' in field 9 generates trace in plotting option

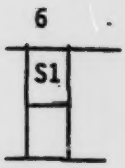
CARD 2 (Roadway Data) contains all the required roadway geometry information, average luminance coefficient, and code to supress the luminance calculation. The card is identified by 'C' in field #1 which must be always present.

1	2
C	

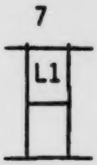
Field #2 (UNIT) designates units
Blank or M, metric units; F designates imperial units.

3 5
Pav't Type

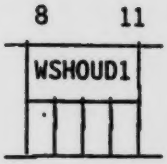
Fields #3 to 5 select pavement type.
Designated by variable (PAVTY).



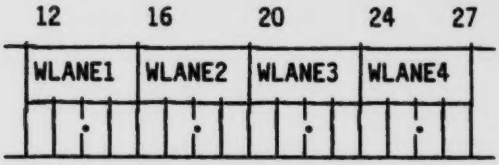
Field #6, designated by S1, is used to specify number of strips on the left-hand shoulder, the variable used is termed [MDIV(1)].



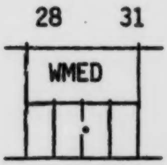
Field #7 designated by L1 is used to input the number of lanes on the left hand roadway (L.R.R.) It is denoted by variable [LANE(1)] in the program.



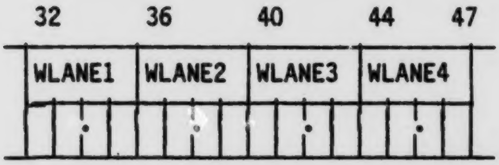
Fields #8-11 [WSHOUD(1)] designate width of L.H. shoulder (i.e., shoulder of roadway 1).



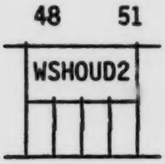
Fields [WLANE(1-4)] #12-27 designate the widths of lanes 1-4, respectively of Roadway 1 to an accuracy of two decimal places.



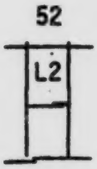
Fields #28-31 (WMED) designate the width of the median to an accuracy of two decimal places.



Fields #32-47 (WLANE(1-4)) designate the width of lanes 1-4, respectively, of Roadway 2 (R.H.R) to an accuracy of two decimals.

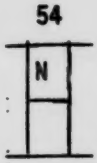


Fields #48-51 (WSHOUD) designate the width of right-hand shoulder (i.e., shoulder of roadway 2).

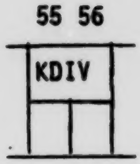


Field #52 (lane 2) designates the number of lane in the right-hand roadway.

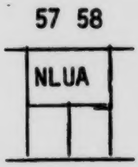
Field #53 [MDIV(2)] designates the number of strips on the right-hand shoulder (i.e., Roadway 2).



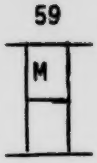
Field #54 (WSTRIP) designates the number of strips per lane.



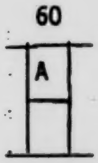
Fields #55-56 (KDIV) designate the number of divisions between each pair of luminaires.



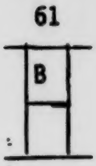
Fields #57-58 (NLUA) designate the number of luminaires in front of and/or behind the study area which will be considered as sources of illumination.



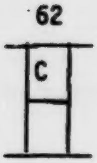
Field #59 (MDIV) designates the number of strips/median.



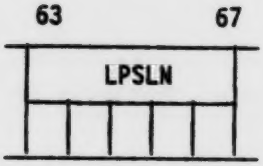
Field #60 (RECODE) designates one-way or two-way traffic flows. Enter 1 if one-way traffic, otherwise leave blank.



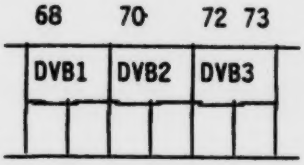
Field #61 (LUCODE) designates the option of supressing luminance calculation. Enter '1' if luminance calculations are not required, otherwise leave blank.



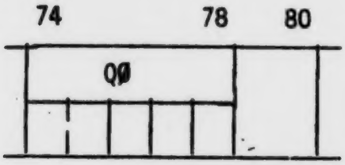
Field #62, designated by (C), indicates whether the highway is divided or not. Enter '1' if the highway is divided, otherwise leave blank.



Fields #63-67 currently not used for input data.



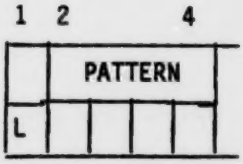
Fields #68-73 designated by (DVBANG) specify the disability veiling brightness angle. Maximum can be 30° 00' 00" and default = 20° 00' 00". The input is in degrees-minutes-seconds.



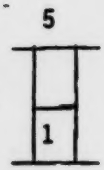
Fields #74-78 designated by (Q0) specify the value of the mean luminance coefficient.

Card #3 -- Luminaire Data Card

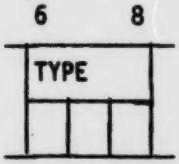
This card contains all the information pertaining to the luminaire type, pattern, mounting height, overhang and their position along the roadway alignment. This card is identified with 'L' in the first field (which must always be present).



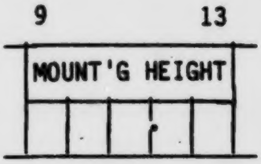
Fields #2-4 are provided for the specification of luminaire pattern. This input is designated by (PATTERN). See input assumptions, paragraph #6.



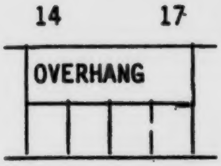
The number 1 in column 5 means that the following four variables are input of luminaire row #1 (fields 6-17).



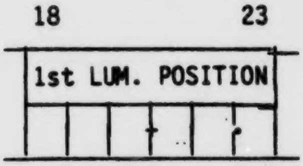
Fields #6-8 are used for the specification of luminaire type number for luminaire row 1. This input is designated by variable (TYPE). See Appendix D for details.



Fields #9-13 are used to specify the height of the luminaire above the roadway surface for luminaire row 1. This input is designated by variable (HT) and the value can represent either feet or metres.



Fields #14-17 are used to specify the distance between luminaire and edge of pavement. The overhang shown on the input sheet is taken as positive. The reverse direction is taken as negative.

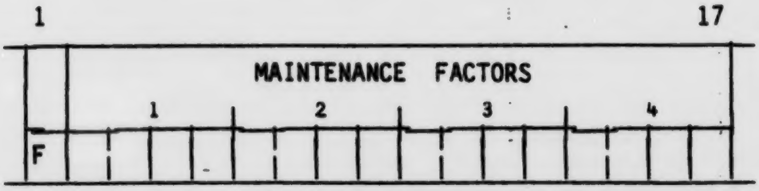


Fields #18-23 are used to input the relative position of the first luminaire in Row 1. In each row the position of the first luminaire is used as reference point for the placement of other luminaires.

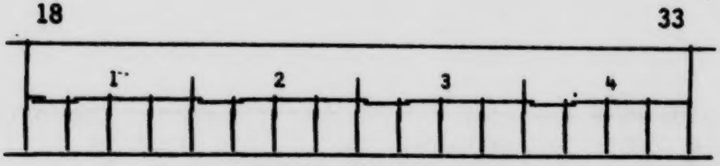
Fields #24-80, repeat the input data of the remaining three rows i.e., Row No., mounting height, overhang and the first luminaire positions, as shown in the input format of the coding sheets.

Card #4 -- Maintenance and Prorating Factor Card

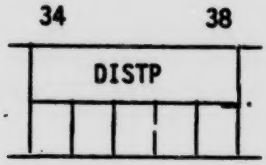
This card is identified by 'F' in the first field which must be always present.



Fields #2-17 are used to input four maintenance factors, one for each row. The default value of each factor is 1.



Fields #18-33 are used to input four prorating factors, one for each row. The default value of each prorating is 1.



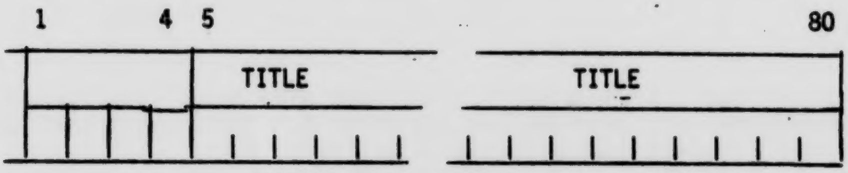
Fields #34-38 are used to input the distance between the poles (i.e., pole spacing) or luminaires. The input can be either in imperial or metric units.

The remaining fields in this card are currently not used.

2.4.2/ ILUM1 -- Original Input Sheets Format

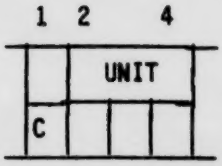
The design criteria parameters are generated according to the grid pattern shown in Figure 8a.

Card #1(Title Card) -- The title card is used to label the job with an appropriate identification. This title is reprinted at the beginning of the output data.

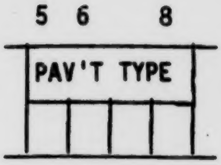


Fields #1-4 of this card are blanked out, the remaining fields #5-80 are used for title.

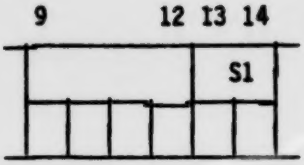
Card #2(Road Data Card) -- The road data card contains the required road data geometry information together with the average luminance coefficient and codes to supress luminance calculations. This card is identified by 'C' in the first field.



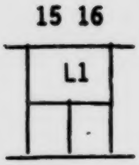
Fields #2-4 are used to input the Imperial or metric units designation (M or F)
- M or (blank) = metric units
- F = Imperial units



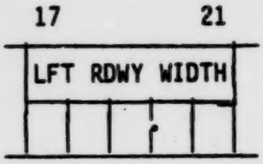
Fields #6-8 are used to input pavement classification type. For details see Appendix D. This input is designated by variable (PVTYE).



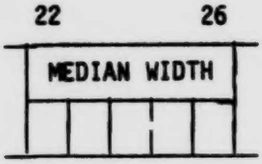
Field #14 is used to input the number of strips on the left shoulder. Maximum is 2 and minimum is 0. Width of strip = L + Roadway Width/L.N. This variable is designated by (MDIV1).



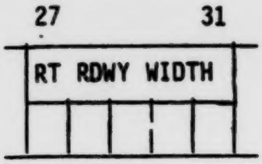
Field #16 is used to input the number of lanes on the left roadway. This variable is designated by (LANE1).



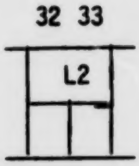
Fields #17-21 are used to input the width of the left roadway. This variable is designated as (RDWAY1) and may be in feet or metres.



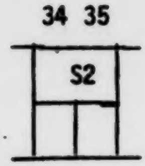
Fields #22-26 are used to input the width of the median strip. This variable is designated as (WMED). The input is either in feet or metres.



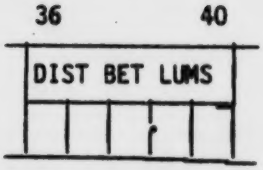
Fields #27-31 are used to input the width of the right roadway. This variable is designated by (RDWAY2). The values are either in Imperial or metric units.



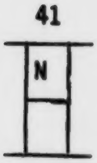
Field #33 is used to input number of lanes in the right roadway. The maximum is 4, the minimum is 0. This variable is designated as (LANE2).



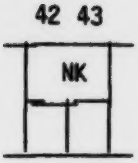
Field #35 is used to input the number of strips on the right shoulder. Maximum is 2 and minimum is 0. This variable is designated as (MDIV2).



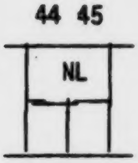
Fields #36-40 are used to input the pole spacings or distances between luminaires. This variable is designated as (DISTP). Input can be in either Imperial or metric units.



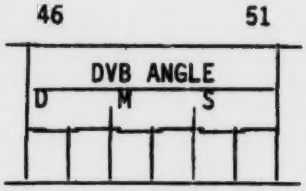
Field #41 is used to input number of strips per lane where N = 4 or 2. This variable is designated as (NSTRIP).



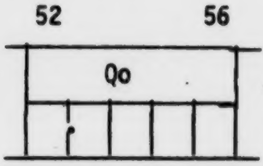
Fields #42-43 are used to input the number of strips or divisions between the luminaire or per interval. This variable is designated by (KDIV). The maximum number of divisions between luminaires is 90.



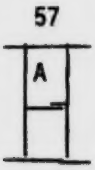
Fields #44-45 are used to input the number of luminaires in front of and behind the study area which will be considered as sources of illumination. Maximum is 12 and minimum is 3. This variable is designated by (NLUA).



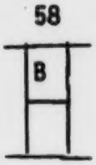
Fields #46-51 are used to input the disability veiling brightness angle. Default value = 20° 00' 00' and maximum angle cannot exceed 30° 00' 00". This variable is designated by (DVBANG). Input is in degrees-minutes-seconds.



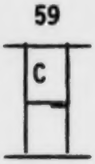
Fields #52-56 are used to input the average luminance coefficient. This variable is designated by Qo.



Field #57 is used to indicate one-way or two-way traffic flow. This variable is designated by (RECODE). One-way traffic is indicated by 1; a blank indicates two-way traffic flow.



Field #58 is used to supress luminance output. This variable is designated by (LUCODE). The entry of '1' will invoke supression of luminance calculations and printing; a blank generates the normal output.



Field #59 is used to indicate highway class:

- 1 -- divided highway
- blank -- undivided highway

The remaining fields on this card (i.e., 60-80) are not utilized.

Card #3 (Luminaire Data Card) and Card #4 (Factor Cards) are similar to the card and explanation shown in Section 2.4 (i.e., revised input format).

APPENDIX A/

A.1/ Files Description

A.2/ Job Control Language Examples for ILUM1

A.1/ Files Description

The ILUM1 program makes use of space on disk or drum and tape if iso-illuminance and iso-luminance plotting is required. The designated areas are referred to in the program as Files 8, 9, 10, 11, 12 and 80.

File #8 -- is an index file for Files 11 and 12. This file is used as an index to control updating and retrieval of photometric luminaire data (File 11) and reduced luminance coefficents values (File 12).

File #9 -- This file is used as a working area, where the calculation and storage of grid plan co-ordinates, illuminance values is performed.

File #10 -- This file is used also as working area for calculation, storage and retrieval of luminance quantitites for each driver position and for setting up the data for plotting.

File #11 -- This file is used to store the luminous intensity tables (I-tables) which describe, in terms of angles ϕ and γ', the directional luminous intensity of each luminaire.

File #12 -- This file is used to store the reduced luminance coefficient tables (r-tables) which describe, in terms of angles β and γ, the directional luminance of specific pavement classes.

File #80 -- This file can be designated either on disk (as shown in JCL examples) or on tape. it is used to store the plotting information which is used in a subsequent "CONTOUR" program to create a plot tape for plotting of iso-illuminance and iso-luminance contours.

File #5 -- This file is used to input data

A.2/ Job Control Language Examples for ILUM1

1/ J.C.L. example where input data is stored on an external file.

```
//ILUMTEST JOB XXXXXXX,'M2,TITISHOV',CLASS=G,NOTIFY=TCERAT,MSGCLASS=A
//*MAIN LINES=(10,CANCEL)
//STEP1 EXEC PGM=NEWILUM1,REGION=250K,TIME=(,30)
//STEPLIB  DD  DSN=TCER.AT.ILUM.LOAD,DISP=SHR
/FT06F001 DD SYSOUT=A
//FT08F001  DD DSN=TCEC.PKDC.ILUM.INDEX2,DISP=OLD
//FT09F001 DD SPACE=(TRK,(10,10)),DISP=NEW,UNIT=VIO,
//        DCB=(RECFM=VBS,LRECL=420,BLKSIZE=4204)
//FT10F001 DD SPACE=(TRK,(5,5)),DISP=NEW,UNIT=VIO,
//    DCB=(RECFM=VBS,LRECL=3826,BLKSIZE=3830)
//FT11F001  DD  DSN=TCEC.PKDC.ILUM.ITBLE2,DISP=OLD
//FT12F001  DD  DSN=TCEC.PKDC.ILUM.RFTBL2,DISP=OLD
//FT80F001  DD  DSN=TCER.AT.PLOTEST.DATA,UNIT=DISK,DISP=(NEW,CATLG,
    DELETE),SPACE=(TRK;(5,1)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
 SYSUDUMP  DD DUMMY
/FT05F001  DD  DSN=TCER.AT.ILUMTEST.DATA(NEWTEST1),DISP=SHR
*
```

2/ J.C.L. example where input data is added on.

```
//ILUMTEST JOB XXXXXXX,'M2,TITISHOV',CLASS=O,NOTIFY=TCERAT,MSGCLASS=A
//*MAIN LINES=(10,CANCEL)
//STEP1 EXEC PGM=NEWILUM1,REGION=250K,TIME=(,30)
//STEPLIB  DD  DSN=TCER.AT.ILUM.LOAD,DISP=SHR
//FT06F001 DD SYSOUT=A
//FT08F001  DD DSN=TCEC.PKDC.ILUM.INDEX2,DISP=OLD
//FT09F001 DD SPACE=(TRK,(10,10)),DISP=NEW,UNIT=VIO,
//        DCB=(RECFM=VBS,LRECL=420,BLKSIZE=4204)
//FT10F001 DD SPACE=(TRK,(5,5)),DISP=NEW,UNIT=VIO,
//    DCB=(RECFM=VBS,LRECL=3826,BLKSIZE=3830)
//FT11F001  DD  DSN=TCEC.PKDC.ILUM.ITBLE2,DISP=OLD
//FT12F001  DD  DSN=TCEC.PKDC.ILUM.RFTBL2,DISP=OLD
//FT80F001  DD  DSN=TCER,AT.PLOTEST.DATA,UNIT=DISK,DISP=(NEW,CATLG,
//    DELETE),SPACE=(TRK,(5,1)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//SYSUDUMP   DD DUMMY
//FT05F001  DD *
TES          USET MANUAL EXAMPLE TEST   -    4 LANE HWY
CF3032210  12  12            18  12  12           10  224 350   1           008
1 2 1 30 30         000 2                  3                  4 30 30     0   12
1 0875        087508          08  240
*
```

3/ J.C.L. example of CONTOUR program to plot iso-illuminance and iso-luminance

```
L
//PLOTTEST JOB XXXXXXX, M2,A.TITISHOV',CLASS=B,NOTIFY=TCERAT
// JOBLIB DD DSN=TCEC.ECSPMAC,DISP=SHR
//CONTOUR1 EXEC PGM=CONTOUR,REGION=200K
//PLOTFLAT DD DSN=TCER.TESTTEMP,UNIT=TAPE9,
//             DISP=(NEW,KEEP,DELETE)
//FT01F001 DD DSN=TCER.AT.PLOTEST.DATA,UNIT=DISK,
//             DISP=(OLD,KEEP,KEEP)
//FT05F001 DD *
        HORIZONTAL ILLUMINANCE
 $CNTOUR IUNIT=1,CONINT=100.,XYSCL=0.5 $END
     LUMINANCE  VIEWED FOM IANE 1
 $CNTOUR IUNIT=1,CONINT=10.,XYSCL=0.5 $END
     LUMINANCE  VIEWED FROM LANE 2
 $CNTOUR IUNIT=1,CONINT=10.,XYSCL=0.5 $END
     LUMINANCE  VIEWED FROM LANE 3
 $CNTOUR IUNIT=1,CONINT=10.,XYSCL=0.5 $END
     LUMINANCE VIEWED FROM LANE 4
 $CNTOUR IUNIT=1,CONINT=10.,XYSCL=0.5 $END
/*
//FT06F001 DD SYSOUT=A
//
```

APPENDIX B/

B.1/ Example of ILUM1 Calculations

B.2/ Graphical Illustration of Calculations

B.1/ Examples of ILUM1 Calculations

```
ILLUMINANCE,LUMINANCE & DISABILITY VEILING BRIGHTNESS ACCORDING TO THE -IES- STANDARDS
       USER MANUAL-EXAMPLE TEST  -  4 LANE HWY

REPRINT INPUT DATA
------- ----- ----

UNIT = FOOT

LUMINAIRE     ROW NUMBER                1                 2                 3                 4
              TYPE                     30                 0                 0                30
              MOUNTING HEIGHT        50.00               0.0               0.0             50.00
              OVER HANG FROM CURB      0.0               0.0               0.0               0.0
              FIRST LUM. POSITION   0+ 0.0            0+ 0.0            0+ 0.0           1+20.00

PATTERN : 2 ROWS STAGGERED
                                  --------
                                     0          -----------------------
                                                   0                 0          --------
DIST. BET'N LUM. POLE = 240.00                                                     0




                               ---------                    -------                          ---------
                                2 LANE |-------2 LANE.--------|18.00|--------2 LANE.---------| 2 LANE
                                STRIPS         24.00 FT          FT         24.00 FT           STRIPS

PAVEMENT TYPE                                =     303 (R3)
LUMINANCE CO-EFFICIENT QO                    =     0.0800
MAINTENANCE FACTOR:        ROW NUMBER 1      =     0.8750 X PRORATING FACTOR OF  0.80 =   0.7000
                           ROW NUMBER 4      =     0.8750 X PRORATING FACTOR OF  0.80 =   0.7000
LUMINAIRE INTERVALS IN FRONT/REAR OF
STUDY AREA FOR CALCULATION                   =     3
NO. OF STRIPS BETWEEN TWO LUM. POLES         =     50
DVD ANGLE LIMIT                              =     20 DEG.  0 MIN.  0 SEC.
SLOPE OF ROAD                                =       0.0  DEG
TWO WAY TRAFFIC (TRAFFIC ON RIGHT ROADWAY INTO DIAGRAM; TRAFFIC ON LEFT ROADWAY OUT OF DIAGRAM)
4 STRIPS PER LANE

LUMINAIRE DESCRIPTION

LAMP CODE   MANUFACTURER     REFERENCE NO     DESCRIPTION                         I.E.S. TYPE     INIT. LUMENS   LIFE SPAN
  30          ITT (WIDELITE)    P0010          400W H.P.S. - HORIZONTAL            III-M-C          50000          24000
```

```
OUTPUT
------

N.B. THE FIRST LUMINAIRE POSITION CORRESPONDS TO Y=0.
     THE LEFT MOST GRID LINE CORRESPONDS TO X=0.

                                         LUMINAIRE CO-ORDINATES
                                         ----------------------

ROW NO. 1     TYPE= 30    X= 10.00
                          Y=     0.0   240.00  480.00  720.00  960.00 1200.00 1440.00 1680.00
ROW NO. 4     TYPE= 30    X= 70.00
                          Y=  120.00   360.00  600.00  840.00 1080.00 1320.00 1560.00
```

```
                                   HORIZONTAL ILLUMINANCE FOR L.H.S.ROADWAY
                                   ----------------------------------------
                                        UNIT=(LUMEN/FT.SQ.)X100.

959.99 |    229   315   328   326   303   310
955.19 |    235   325   330   324   305   319
950.39 |    218   298   314   316   299   314
945.59 |    205   262   267   279   277   285
940.79 |    199   246   250   257   250   236
935.99 |    198   232   236   242   239   226
931.19 |    191   213   215   220   230   221
926.39 |    176   192   189   198   209   209
921.59 |    161   180   178   184   193   197
916.79 |    146   165   168   174   184   185
911.99 |    129   147   157   165   171   172
907.19 |    119   137   147   154   158   162
902.39 |    112   131   140   147   151   155
897.59 |    104   124   135   143   148   155
892.79 |     99   119   132   143   151   159
887.99 |     91   114   129   142   153   165
883.19 |     92   111   124   139   154   169
878.39 |     93   111   124   139   156   176
873.59 |     94   114   129   145   162   186
868.79 |     99   123   142   160   175   195
863.99 |    107   138   158   179   196   205
859.19 |    115   150   171   195   218   239
854.39 |    123   163   185   211   234   259
849.59 |    128   166   186   214   239   270
844.79 |    132   163   177   201   229   254
839.99 |    129   161   176   204   231   252
835.20 |    132   163   177   201   229   254
830.40 |    128   166   186   214   239   270
825.60 |    123   162   185   211   234   259
820.80 |    115   150   171   195   218   239
816.00 |    106   138   158   179   196   205
811.20 |     99   122   142   160   175   195
806.40 |     94   113   129   145   162   186
801.60 |     93   111   124   139   156   176
796.80 |     92   111   124   139   154   169
792.00 |     91   114   129   142   153   165
787.20 |     96   119   132   143   151   159
782.40 |    104   124   135   143   148   155
777.60 |    112   131   140   147   151   155
772.80 |    119   137   147   154   158   162
768.00 |    129   148   157   165   171   172
763.20 |    146   165   168   174   184   185
758.40 |    161   180   178   184   193   197
753.60 |    176   192   189   198   209   209
748.80 |    191   213   215   220   230   221
744.00 |    198   232   236   242   239   226
739.20 |    199   246   250   257   250   236
734.40 |    205   263   267   279   277   285
729.60 |    218   298   315   316   299   314
724.80 |    235   325   330   324   305   319
720.00 |    228   315   326   326   303   310
       +--------------------------------------------------------------------
   Y /
    /X      5.0  13.0  19.0  25.0  31.0  38.5
```

```
                                    VERTICAL ILLUMINANCE FOR L.H.S.ROADWAY
                                    --------------------------------------
                                         UNIT=(LUMEN/FT.SQ.)X100.

   959.99 |    44    59    72    80    82    92
   955.19 |    65    89    99   103   107   117
   950.39 |    82   110   120   124   126   137
   945.59 |    95   123   129   135   138   148
   940.79 |   111   134   137   143   143   143
   935.99 |   126   145   146   149   149   148
   931.19 |   135   150   144   150   150   151
   926.39 |   139   148   145   148   155   151
   921.59 |   139   150   147   148   151   149
   916.79 |   136   147   146   148   151   145
   911.99 |   127   137   141   144   144   136
   907.19 |   121   131   135   136   133   124
   902.39 |   117   128   130   130   125   116
   897.59 |   111   123   124   124   120   111
   892.79 |   104   116   119   120   116   109
   887.99 |    98   111   115   114   111   101
   883.19 |    96   105   107   107   105    97
   878.39 |    94   102   102   101   100    94
   873.59 |    92    97    96    99   100    96
   868.79 |    91   102   102   104   103    99
   863.99 |    92   112   114   111   107   101
   859.19 |    94   121   124   119   116   105
   854.39 |    98   132   137   126   118   106
   849.59 |    93   128   131   123   115   105
   844.79 |    89   107   100    99    99   100
   839.99 |    80    96    89    90    93    97
   835.20 |    77    94    93    96   104   111
   830.40 |    73    92    99   115   121   130
   825.60 |    69    91   106   122   130   140
   820.80 |    66    89   108   124   132   143
   816.00 |    62    84   105   121   130   136
   811.20 |    56    78    99   110   119   132
   806.40 |    55    73    89   102   113   132
   801.60 |    51    67    81    95   110   128
   796.80 |    48    62    76    91   105   124
   792.00 |    43    59    72    87   101   119
   787.20 |    41    56    69    82    93   109
   782.40 |    38    51    62    73    83   101
   777.60 |    36    49    58    68    78    94
   772.80 |    35    47    55    64    74    90
   768.00 |    34    45    52    61    72    88
   763.20 |    32    43    50    60    71    87
   758.40 |    32    42    49    60    71    88
   753.60 |    32    41    50    62    73    90
   748.80 |    35    44    57    68    80    90
   744.00 |    34    46    59    71    84    93
   739.20 |    34    49    61    75    85    94
   734.40 |    36    51    63    75    86    94
   729.60 |    38    54    67    76    83    92
   724.80 |    42    57    69    77    83    91
   720.00 |    44    59    72    80    82    92
          +------------------------------------------------------------
      Y /
       /X      5.0  13.0  19.0  25.0  31.0  38.5
```

HORIZONTAL ILLUMINANCE FOR R.H.S.ROADWAY

UNIT=(LUMEN/FT.SQ.)X100.

Y / /X	47.5	55.0	61.0	67.0	73.0	81.0
959.99	252	231	204	176	161	129
955.19	254	229	201	177	163	132
950.39	270	239	214	186	166	128
945.59	259	234	211	185	162	123
940.79	239	218	195	171	150	115
935.99	205	196	179	158	138	106
931.19	195	175	160	142	122	99
926.39	186	162	145	129	113	94
921.59	176	156	139	124	111	93
916.79	169	154	139	124	111	92
911.99	165	153	142	129	114	91
907.19	159	151	143	132	119	96
902.39	155	148	143	135	124	104
897.59	155	151	147	140	131	112
892.79	162	158	154	147	137	119
887.99	172	171	165	157	148	129
883.19	185	184	174	168	165	146
878.39	197	193	184	178	180	161
873.59	209	204	196	189	192	176
868.79	221	230	220	216	213	191
863.99	226	239	242	236	232	198
859.19	236	250	257	250	246	199
854.39	285	277	279	267	263	205
849.59	314	299	316	315	298	218
844.79	319	305	324	336	325	235
839.99	310	303	326	328	315	229
835.20	319	305	324	336	325	235
830.40	314	299	316	315	298	218
825.60	285	277	279	267	262	205
820.80	236	250	257	250	246	199
816.00	226	239	242	236	232	198
811.20	221	230	220	215	213	191
806.40	209	209	198	189	192	176
801.60	197	193	184	178	180	161
796.80	185	184	174	166	165	146
792.00	172	171	165	157	148	129
787.20	162	158	154	147	137	119
782.40	155	151	147	140	131	112
777.60	155	146	143	135	124	104
772.80	159	151	143	132	119	96
768.00	165	153	142	129	114	91
763.20	169	154	139	124	111	92
758.40	176	156	139	124	111	93
753.60	186	162	145	129	114	94
748.80	195	175	160	142	122	99
744.00	205	196	179	158	138	107
739.20	239	218	195	171	150	115
734.40	259	234	211	165	163	123
729.60	270	239	214	186	166	128
724.80	254	229	201	177	163	132
720.00	252	231	204	176	161	129

```
                                     VERTICAL ILLUMINANCE FOR R.H.S.ROADWAY
                                     --------------------------------------
                                           UNIT=(LUMEN/FT.SQ.)X100.

 959.99 |    97    93    90    90    96    80
 955.19 |   100    99    99   100   107    89
 950.39 |   105   115   123   131   128    93
 945.59 |   106   116   126   137   132    98
 940.79 |   105   116   119   124   121    94
 935.99 |   101   107   111   114   112    97
 931.19 |    99   103   104   102   102    91
 926.39 |    97   100    99    96    97    92
 921.59 |    94   100   101   102   102    94
 916.79 |    97   105   107   107   105    96
 911.99 |   101   111   114   115   111    98
 907.19 |   106   116   120   119   116   104
 902.39 |   111   120   124   124   123   111
 897.59 |   116   125   130   130   128   117
 892.79 |   125   133   136   135   132   121
 887.99 |   136   144   144   141   137   127
 883.19 |   145   151   148   147   147   136
 878.39 |   149   151   148   147   150   140
 873.59 |   151   155   149   145   148   139
 868.79 |   151   156   150   149   150   136
 863.99 |   148   149   149   146   145   126
 859.19 |   143   143   143   137   134   111
 854.39 |   148   138   135   124   123    95
 849.59 |   137   126   124   120   110    82
 844.79 |   117   107   103    99    89    65
 839.99 |    92    82    80    72    59    44
 835.20 |    91    83    77    69    57    42
 830.40 |    92    83    76    67    54    38
 825.60 |    94    86    75    63    51    36
 820.80 |    94    85    74    61    49    34
 816.00 |    93    84    71    59    46    34
 811.20 |    90    80    66    57    44    35
 806.40 |    90    73    62    50    41    32
 801.60 |    86    71    60    49    42    32
 796.80 |    88    71    59    50    43    32
 792.00 |    86    72    61    52    45    34
 787.20 |    90    74    64    55    47    35
 782.40 |    94    76    66    58    49    36
 777.60 |   100    83    73    62    51    38
 772.80 |   109    93    82    69    56    41
 768.00 |   119   100    87    72    59    43
 763.20 |   124   105    91    75    62    48
 758.40 |   128   110    95    81    67    51
 753.60 |   132   113   102    89    73    55
 748.80 |   132   119   110    99    78    56
 744.00 |   136   130   121   105    84    62
 739.20 |   143   132   123   108    89    66
 734.40 |   140   130   122   108    91    69
 729.60 |   129   121   115    99    92    73
 724.80 |   111   103    98    93    94    77
 720.00 |    96    93    90    89    96    80
        +----------------------------------------------------------------
   Y /
    /X     47.5  55.0  61.0  67.0  73.0  81.0
```

```
                                   HORIZONTAL ILLUMINANCE CHARACTERISTICS
                                   --------------------------------------
                                           UNIT=LUMEN/FT.SQ.

ROADWAY VALUES FOR:

            L.H.S.
            SHOULDER       LANE NO. 1     LANE NO. 2

AVG          1.4217         1.6051         2.0217
MAX          2.3589         3.3612         3.2665
MIN          0.9194         1.1103         1.3976
MAX/AVG      1.6592         1.6621         1.6157
AVG/MIN      1.5464         1.6256         1.4466
MAX/MIN      2.5656         3.0273         2.3373

ROADWAY VALUES FOR:

            MEDIAN         LANE NO. 3     LANE NO. 4     RHS. SHOULDER

AVG          2.1624         2.0217         1.6052         1.4218
MAX          3.1978         3.2665         3.3613         2.3591
MIN          1.5534         1.3976         1.1103         0.9194
MAX/AVG      1.4788         1.6157         1.6620         1.6592
AVG/MIN      1.3926         1.4466         1.6258         1.5465
MAX/MIN      2.0585         2.3373         3.0273         2.5659

ROADWAY VALUES SUMMARY

            LEFT SIDE      RIGHT SIDE

AVG          1.8065         1.8065
MAX          3.3612         3.3613
MIN          0.8044         0.8044
MAX/AVG      1.8586         1.8585
AVG/MIN      1.9671         1.9671
MAX/MIN      3.6560         3.6560
```

```
                                 VERTICAL ILLUMINANCE CHARACTERISTICS
                                 ------------------------------------
                                          UNIT=LUMEN/FT.SQ.

ROADWAY VALUES FOR:

              L.H.S.
              SHOULDER        LANE NO. 1      LANE NO. 2

AVG           0.7589          0.9521          1.0709
MAX           1.3993          1.5066          1.5655
MIN           0.3253          0.4109          0.6006
MAX/AVG       1.6439          1.5818          1.4619
AVG/MIN       2.3327          2.3168          1.7624
MAX/MIN       4.3012          3.6648          2.6063

ROADWAY VALUES FOR:

              MEDIAN          LANE NO. 3      LANE NO. 4      RHS. SHOULDER

AVG           1.1387          1.0709          0.9521          0.7589
MAX           1.5145          1.5661          1.5066          1.4001
MIN           0.8644          0.6000          0.4103          0.3246
MAX/AVG       1.3301          1.4625          1.5827          1.6450
AVG/MIN       1.3173          1.7649          2.3206          2.3375
MAX/MIN       1.7521          2.6104          3.6727          4.3126

ROADWAY VALUES SUMMARY

              LEFT SIDE       RIGHT SIDE

AVG           0.9575          0.9575
MAX           1.5655          1.5661
MIN           0.3253          0.3246
MAX/AVG       1.6350          1.6357
AVG/MIN       2.9432          2.9493
MAX/MIN       4.8120          4.8241
```

```
N.B. WHEN THERE IS MEDIAN, LUMINANCE WILL BE GIVEN ONLY FOR THE ROADWAY WHERE THE DRIVER BELONGS

                                   LUMINANCE FOR L.H.S. ROADWAY WHEN DRIVING ALONG LANE 1
                                   ------------------------------------------------------
                                                    UNIT=FT.L.
   959.99 |   0.27  0.38  0.40  0.40  0.40  0.47
   955.19 |   0.27  0.38  0.39  0.39  0.47  0.57
   950.39 |   0.24  0.34  0.41  0.44  0.46  0.56
   945.59 |   0.23  0.33  0.36  0.40  0.44  0.53
   940.79 |   0.24  0.32  0.34  0.37  0.40  0.47
   935.99 |   0.25  0.30  0.32  0.35  0.38  0.44
   931.19 |   0.24  0.26  0.29  0.31  0.36  0.41
   926.39 |   0.21  0.24  0.24  0.27  0.32  0.39
   921.59 |   0.19  0.23  0.23  0.26  0.30  0.36
   916.79 |   0.18  0.22  0.22  0.25  0.29  0.35
   911.99 |   0.17  0.21  0.22  0.24  0.28  0.33
   907.19 |   0.17  0.22  0.22  0.24  0.26  0.33
   902.39 |   0.16  0.23  0.23  0.24  0.26  0.32
   897.59 |   0.19  0.25  0.24  0.24  0.26  0.32
   892.79 |   0.21  0.30  0.27  0.27  0.28  0.32
   887.99 |   0.23  0.33  0.30  0.28  0.29  0.33
   883.19 |   0.25  0.36  0.32  0.29  0.29  0.33
   878.39 |   0.27  0.40  0.34  0.31  0.30  0.33
   873.59 |   0.30  0.44  0.38  0.33  0.31  0.33
   868.79 |   0.32  0.49  0.44  0.36  0.33  0.34
   863.99 |   0.35  0.55  0.48  0.41  0.37  0.35
   859.19 |   0.39  0.61  0.52  0.44  0.40  0.39
   854.39 |   0.42  0.66  0.56  0.46  0.42  0.42
   849.59 |   0.46  0.69  0.54  0.46  0.42  0.42
   844.79 |   0.60  0.81  0.52  0.42  0.40  0.40
   839.99 |   0.63  0.85  0.69  0.53  0.49  0.47
   835.20 |   0.67  0.90  0.88  0.53  0.48  0.45
   830.40 |   0.66  0.99  0.82  0.61  0.52  0.48
   825.60 |   0.65  0.97  0.82  0.62  0.52  0.47
   820.80 |   0.60  0.85  0.72  0.56  0.49  0.44
   816.00 |   0.55  0.75  0.64  0.52  0.44  0.39
   811.20 |   0.51  0.63  0.55  0.47  0.41  0.38
   806.40 |   0.48  0.56  0.49  0.43  0.38  0.36
   801.60 |   0.46  0.55  0.46  0.42  0.37  0.34
   796.80 |   0.44  0.53  0.48  0.42  0.37  0.34
   792.00 |   0.42  0.53  0.49  0.43  0.38  0.34
   787.20 |   0.42  0.52  0.48  0.42  0.38  0.34
   782.40 |   0.42  0.51  0.46  0.40  0.37  0.34
   777.60 |   0.41  0.49  0.45  0.40  0.36  0.35
   772.80 |   0.40  0.47  0.44  0.39  0.37  0.36
   768.00 |   0.40  0.46  0.43  0.40  0.39  0.39
   763.20 |   0.40  0.47  0.43  0.40  0.40  0.41
   758.40 |   0.40  0.46  0.42  0.40  0.40  0.42
   753.60 |   0.39  0.44  0.41  0.40  0.41  0.43
   748.80 |   0.36  0.43  0.42  0.41  0.42  0.45
   744.00 |   0.35  0.42  0.41  0.42  0.42  0.46
   739.20 |   0.32  0.41  0.40  0.41  0.41  0.46
   734.40 |   0.29  0.40  0.40  0.41  0.43  0.51
   729.60 |   0.29  0.40  0.43  0.43  0.44  0.53
   724.80 |   0.29  0.41  0.42  0.41  0.43  0.52
   720.00 |   0.27  0.36  0.40  0.40  0.40  0.47
          +-----------------------------------------------------------------
     Y /
    . /X      5.0  13.0  19.0  25.0  31.0  38.5
```

N.B. WHEN THERE IS MEDIAN, LUMINANCE WILL BE GIVEN ONLY FOR THE ROADWAY WHERE THE DRIVER BELONGS

LUMINANCE FOR L.H.S. ROADWAY WHEN DRIVING ALONG LANE 2

UNIT=FT.L.

959.99	0.26	0.37	0.40	0.40	0.38	0.44
955.19	0.26	0.37	0.40	0.39	0.45	0.53
950.39	0.24	0.33	0.41	0.43	0.44	0.52
945.59	0.22	0.33	0.36	0.39	0.42	0.49
940.79	0.23	0.31	0.34	0.37	0.39	0.43
935.99	0.23	0.30	0.33	0.34	0.37	0.41
931.19	0.23	0.28	0.30	0.31	0.35	0.39
926.39	0.20	0.23	0.24	0.26	0.31	0.37
921.59	0.19	0.22	0.22	0.25	0.29	0.34
916.79	0.18	0.21	0.22	0.24	0.28	0.33
911.99	0.16	0.21	0.22	0.24	0.27	0.32
907.19	0.16	0.21	0.23	0.24	0.26	0.31
902.39	0.16	0.23	0.24	0.24	0.26	0.30
897.59	0.17	0.25	0.27	0.25	0.26	0.30
892.79	0.18	0.30	0.32	0.29	0.28	0.31
887.99	0.19	0.33	0.36	0.31	0.30	0.32
883.19	0.21	0.36	0.39	0.33	0.31	0.32
878.39	0.23	0.40	0.43	0.35	0.32	0.33
873.59	0.24	0.44	0.47	0.38	0.33	0.33
868.79	0.26	0.49	0.55	0.42	0.36	0.34
863.99	0.29	0.56	0.61	0.48	0.40	0.36
859.19	0.32	0.61	0.65	0.52	0.43	0.40
854.39	0.35	0.67	0.69	0.55	0.45	0.42
849.59	0.36	0.70	0.66	0.54	0.45	0.43
844.79	0.51	0.82	0.64	0.49	0.43	0.41
839.99	0.54	0.86	0.76	0.61	0.53	0.48
835.20	0.57	0.91	0.79	0.62	0.52	0.47
830.40	0.56	1.00	0.95	0.71	0.57	0.50
825.60	0.56	0.98	0.95	0.71	0.56	0.48
820.80	0.52	0.85	0.83	0.64	0.53	0.45
816.00	0.48	0.75	0.72	0.58	0.46	0.40
811.20	0.45	0.64	0.61	0.52	0.43	0.38
806.40	0.43	0.57	0.54	0.47	0.41	0.36
801.60	0.41	0.55	0.53	0.46	0.39	0.34
796.80	0.40	0.54	0.52	0.46	0.40	0.34
792.00	0.36	0.53	0.53	0.46	0.40	0.34
787.20	0.38	0.52	0.51	0.45	0.39	0.34
782.40	0.39	0.50	0.50	0.43	0.36	0.34
777.60	0.39	0.49	0.48	0.41	0.37	0.34
772.80	0.38	0.47	0.47	0.41	0.37	0.35
768.00	0.38	0.46	0.46	0.41	0.39	0.37
763.20	0.38	0.47	0.45	0.41	0.40	0.38
758.40	0.38	0.45	0.43	0.41	0.40	0.39
753.60	0.36	0.43	0.42	0.41	0.41	0.40
748.80	0.37	0.43	0.43	0.42	0.42	0.41
744.00	0.34	0.42	0.42	0.42	0.40	0.42
739.20	0.31	0.40	0.41	0.41	0.40	0.42
734.40	0.28	0.40	0.41	0.41	0.42	0.47
729.60	0.28	0.40	0.44	0.43	0.43	0.49
724.80	0.28	0.40	0.42	0.41	0.42	0.48
720.00	0.26	0.37	0.40	0.40	0.38	0.44
Y / /X	5.0	13.0	19.0	25.0	31.0	38.5

```
N.B. WHEN THERE IS MEDIAN, LUMINANCE WILL BE GIVEN ONLY FOR THE ROADWAY WHERE THE DRIVER BELONGS

                                     LUMINANCE FOR R.H.S. ROADWAY WHEN DRIVING ALONG LANE 3
                                     ------------------------------------------------------
                                                         UNIT-FT.L.

  959.99 |    0.49  0.54  0.65  0.79  0.85  0.51
  955.19 |    0.41  0.44  0.52  0.68  0.81  0.46
  950.39 |    0.44  0.47  0.56  0.70  0.68  0.36
  945.59 |    0.43  0.47  0.58  0.74  0.65  0.33
  940.79 |    0.41  0.45  0.55  0.70  0.59  0.30
  935.99 |    0.37  0.42  0.51  0.65  0.54  0.27
  931.19 |    0.35  0.37  0.45  0.59  0.48  0.25
  926.39 |    0.34  0.35  0.40  0.50  0.43  0.23
  921.59 |    0.33  0.33  0.37  0.45  0.39  0.21
  916.79 |    0.32  0.32  0.35  0.41  0.35  0.20
  911.99 |    0.32  0.31  0.33  0.37  0.32  0.18
  907.19 |    0.31  0.29  0.30  0.33  0.29  0.17
  902.39 |    0.30  0.26  0.26  0.27  0.24  0.16
  897.59 |    0.30  0.26  0.25  0.24  0.22  0.16
  892.79 |    0.30  0.26  0.24  0.23  0.21  0.16
  887.99 |    0.31  0.27  0.24  0.22  0.20  0.16
  883.19 |    0.32  0.28  0.24  0.22  0.21  0.17
  878.39 |    0.34  0.28  0.25  0.22  0.22  0.19
  873.59 |    0.36  0.30  0.26  0.24  0.23  0.20
  868.79 |    0.38  0.34  0.31  0.30  0.27  0.22
  863.99 |    0.40  0.37  0.34  0.33  0.29  0.23
  859.19 |    0.43  0.39  0.37  0.34  0.31  0.23
  854.39 |    0.46  0.42  0.39  0.36  0.32  0.22
  849.59 |    0.51  0.44  0.43  0.41  0.33  0.23
  844.79 |    0.52  0.44  0.39  0.40  0.37  0.26
  839.99 |    0.43  0.38  0.40  0.40  0.37  0.26
  835.20 |    0.47  0.41  0.41  0.42  0.40  0.28
  830.40 |    0.46  0.42  0.43  0.44  0.39  0.28
  825.60 |    0.46  0.41  0.41  0.41  0.39  0.28
  820.80 |    0.41  0.40  0.42  0.41  0.40  0.30
  816.00 |    0.41  0.40  0.42  0.42  0.41  0.34
  811.20 |    0.40  0.42  0.42  0.43  0.42  0.36
  806.40 |    0.39  0.41  0.41  0.42  0.43  0.37
  801.60 |    0.38  0.40  0.41  0.43  0.45  0.38
  796.80 |    0.38  0.40  0.41  0.46  0.46  0.38
  792.00 |    0.36  0.39  0.42  0.47  0.46  0.37
  787.20 |    0.34  0.37  0.42  0.48  0.47  0.37
  782.40 |    0.33  0.37  0.42  0.49  0.49  0.36
  777.60 |    0.34  0.38  0.44  0.51  0.50  0.38
  772.80 |    0.35  0.40  0.46  0.52  0.51  0.37
  768.00 |    0.35  0.41  0.47  0.54  0.53  0.37
  763.20 |    0.34  0.41  0.47  0.54  0.53  0.39
  758.40 |    0.34  0.40  0.47  0.54  0.55  0.40
  753.60 |    0.36  0.42  0.48  0.55  0.56  0.42
  748.80 |    0.38  0.45  0.54  0.62  0.63  0.44
  744.00 |    0.40  0.49  0.60  0.74  0.75  0.46
  739.20 |    0.46  0.55  0.67  0.85  0.85  0.49
  734.40 |    0.49  0.58  0.75  0.96  0.97  0.53
  729.60 |    0.50  0.59  0.76  0.99  0.99  0.53
  724.80 |    0.48  0.53  0.65  0.82  0.90  0.54
  720.00 |    0.49  0.54  0.65  0.79  0.85  0.51
         +------------------------------------------------------------
      Y /
       /X     47.5  55.0  61.0  67.0  73.0  81.0
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N.B. WHEN THERE IS MEDIAN, LUMINANCE WILL BE GIVEN ONLY FOR THE ROADWAY WHERE THE DRIVER BELONGS

                              LUMINANCE FOR R.H.S. ROADWAY WHEN DRIVING ALONG LANE 4
                              ------------------------------------------------------
                                                  UNIT=FT.L.

 959.99 |    0.47  0.50  0.55  0.70  0.86  0.61
 955.19 |    0.40  0.40  0.44  0.56  0.82  0.57
 950.39 |    0.43  0.43  0.49  0.57  0.71  0.43
 945.59 |    0.42  0.43  0.49  0.59  0.68  0.40
 940.79 |    0.40  0.41  0.46  0.56  0.62  0.36
 935.99 |    0.36  0.38  0.43  0.52  0.57  0.33
 931.19 |    0.34  0.34  0.36  0.47  0.50  0.30
 926.39 |    0.33  0.31  0.34  0.41  0.45  0.28
 921.59 |    0.33  0.30  0.32  0.37  0.41  0.26
 916.79 |    0.33  0.29  0.30  0.34  0.37  0.24
 911.99 |    0.33  0.29  0.29  0.31  0.34  0.21
 907.19 |    0.32  0.28  0.27  0.29  0.31  0.20
 902.39 |    0.31  0.26  0.25  0.25  0.26  0.16
 897.59 |    0.31  0.26  0.24  0.23  0.23  0.17
 892.79 |    0.32  0.26  0.24  0.22  0.22  0.17
 887.99 |    0.33  0.27  0.24  0.22  0.21  0.17
 883.19 |    0.34  0.28  0.25  0.22  0.22  0.18
 878.39 |    0.36  0.29  0.25  0.23  0.23  0.19
 873.59 |    0.38  0.31  0.27  0.24  0.24  0.20
 868.79 |    0.40  0.35  0.31  0.29  0.29  0.23
 863.99 |    0.43  0.38  0.34  0.32  0.31  0.24
 859.19 |    0.46  0.40  0.37  0.34  0.32  0.24
 854.39 |    0.52  0.43  0.39  0.36  0.33  0.23
 849.59 |    0.55  0.45  0.43  0.41  0.34  0.24
 844.79 |    0.56  0.46  0.39  0.39  0.36  0.27
 839.99 |    0.46  0.39  0.40  0.40  0.38  0.27
 835.20 |    0.51  0.42  0.41  0.42  0.41  0.29
 830.40 |    0.51  0.43  0.43  0.43  0.40  0.29
 825.60 |    0.50  0.42  0.41  0.40  0.40  0.29
 820.80 |    0.45  0.41  0.41  0.40  0.41  0.32
 816.00 |    0.44  0.41  0.42  0.42  0.43  0.35
 811.20 |    0.43  0.42  0.41  0.42  0.43  0.37
 806.40 |    0.42  0.41  0.41  0.41  0.44  0.38
 801.60 |    0.40  0.40  0.40  0.42  0.46  0.39
 796.80 |    0.40  0.40  0.40  0.43  0.47  0.40
 792.00 |    0.38  0.39  0.40  0.44  0.47  0.39
 787.20 |    0.36  0.37  0.40  0.45  0.48  0.39
 782.40 |    0.34  0.36  0.40  0.46  0.50  0.41
 777.60 |    0.34  0.37  0.41  0.48  0.51  0.41
 772.80 |    0.34  0.38  0.43  0.49  0.52  0.40
 768.00 |    0.34  0.39  0.44  0.50  0.53  0.41
 763.20 |    0.34  0.38  0.43  0.49  0.54  0.42
 758.40 |    0.34  0.37  0.43  0.50  0.56  0.44
 753.60 |    0.36  0.39  0.44  0.50  0.57  0.46
 748.80 |    0.38  0.41  0.48  0.57  0.64  0.49
 744.00 |    0.39  0.45  0.53  0.67  0.75  0.53
 739.20 |    0.44  0.50  0.58  0.76  0.86  0.56
 734.40 |    0.47  0.53  0.64  0.87  0.98  0.63
 729.60 |    0.48  0.54  0.64  0.87  1.00  0.63
 724.80 |    0.46  0.49  0.55  0.72  0.91  0.64
 720.00 |    0.47  0.50  0.55  0.70  0.86  0.61
        +----------------------------------------------------------------------
     Y /
      /X     47.5  55.0  61.0  67.0  73.0  81.0
```

LUMINANCE CHARACTERISTICS

UNIT=FT.L.

ROADWAY VALUES FOR:

	LANE NO. 1	LANE NO. 2	LANE NO. 3	LANE NO. 4
AVG	0.4043	0.4047	0.4054	0.4046
MAX	0.9881	0.9960	0.9884	0.9996
MIN	0.1736	0.1622	0.1598	0.1697
MAX/AVG	2.4436	2.4610	2.4383	2.4705
AVG/MIN	2.3294	2.4953	2.5370	2.3839
MAX/MIN	5.6926	6.1410	6.1860	5.8894

ROADWAY VALUES SUMMARY

	LEFT SIDE	RIGHT SIDE
AVG	0.4045	0.4050
MAX	0.9960	0.9996
MIN	0.1622	0.1598
MAX/AVG	2.4622	2.4662
AVG/MIN	2.4941	2.5346
MAX/MIN	6.1410	6.2559

LANE VALUES FOR DRIVER IN:

	LANE NO. 1	LANE NO. 2	LANE NO. 3	LANE NO. 4
AVG	0.4559	0.4064	0.3931	0.4241
MAX	0.9881	0.7150	0.5874	0.8722
MIN	0.2122	0.2385	0.2585	0.2191
MAX/AVG	2.1673	1.7594	1.4943	2.0567
AVG/MIN	2.1482	1.7038	1.5205	1.9353
MAX/MIN	4.6558	2.9978	2.2720	3.9804

LANE VALUES SUMMARY

	LEFT SIDE	RIGHT SIDE
AVG	0.4311	0.4086
MAX	0.9881	0.8722
MIN	0.2122	0.2191
MAX/AVG	2.2918	2.1347
AVG/MIN	2.0315	1.8646
MAX/MIN	4.6558	3.9804

DISABILITY VEILING BRIGHTNESS

UNIT—FT.L.

NOTE. DVB GIVEN ARE FOR DRIVER POSITION (X,Y)

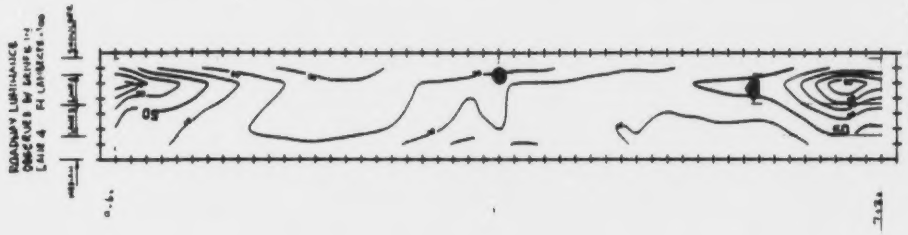
	LANE NO. 1			LANE NO. 2			LANE NO. 3			LANE NO. 4	
X	Y	DVB	X	Y	DVB	X	Y	DVB	X	Y	DVB
12.00	1019.99	0.026	24.00	1019.99	0.027	58.00	660.00	0.015	70.00	660.00	0.015
	1024.79	0.025		1024.79	0.026		655.20	0.014		655.20	0.014
	1029.59	0.025		1029.59	0.027		650.40	0.020		650.40	0.020
	1034.39	0.024		1034.39	0.026		645.60	0.020		645.60	0.019
	1039.19	0.023		1039.19	0.025		640.80	0.020		640.80	0.019
	1043.99	0.022		1043.99	0.024		636.00	0.019		636.00	0.019
	1048.79	0.022		1048.79	0.023		631.20	0.019		631.20	0.019
	1053.59	0.021		1053.59	0.022		626.40	0.019		626.40	0.018
	1058.39	0.020		1058.39	0.021		621.60	0.018		621.60	0.018
	1063.19	0.019		1063.19	0.021		616.80	0.018		616.80	0.018
	1067.99	0.018		1067.99	0.019		612.00	0.018		612.00	0.018
	1072.79	0.018		1072.79	0.018		607.20	0.017		607.20	0.017
	1077.59	0.017		1077.59	0.018		602.40	0.017		602.40	0.017
	1082.39	0.017		1082.39	0.017		597.60	0.017		597.60	0.017
	1087.19	0.070		1087.19	0.087		592.80	0.047		592.80	0.037
	1091.99	0.065		1091.99	0.083		588.00	0.046		588.00	0.037
	1096.79	0.060		1096.79	0.071		583.20	0.045		583.20	0.037
	1101.59	0.054		1101.59	0.064		578.40	0.043		578.40	0.036
	1106.39	0.049		1106.39	0.056		573.60	0.042		573.60	0.034
	1111.19	0.043		1111.19	[illegible]		568.80	0.039		568.80	0.033
	1115.99	0.037		1115.99	[illegible]		564.00	0.037		564.00	0.032
	1120.79	0.028		1120.79	[illegible]		559.20	0.035		559.20	0.031
	1125.59	0.023		1125.59	[illegible]		554.40	0.033		554.40	0.030
	1130.39	0.020		1130.39	0.023		549.60	0.031		549.60	0.029
	1135.19	0.019		1135.19	0.017		544.80	0.030		544.80	0.028
	1139.99	0.017		1139.99	0.016		540.00	0.029		540.00	0.028
	1144.79	0.016		1144.79	0.015		535.20	0.030		535.20	0.027
	1149.59	0.022		1149.59	[illegible]		530.40	0.029		530.40	0.026
	1154.39	0.021		1154.39	0.021		525.60	0.028		525.60	0.026
	1159.19	0.021		1159.19	0.021		520.80	0.026		520.80	0.025
	1163.99	0.021		1163.99	0.021		516.00	0.025		516.00	0.024
	1168.79	0.021		1168.79	0.021		511.20	0.025		511.20	0.023
	1173.59	0.021		1173.59	0.021		506.40	0.024		506.40	0.022
	1178.39	0.020		1178.39	0.020		501.60	0.023		501.60	0.022
	1183.19	0.020		1183.19	0.020		496.80	0.022		496.80	0.021
	1187.99	0.020		1187.99	0.020		492.00	0.020		492.00	0.020
	1192.79	0.020		1192.79	[illegible]		487.20	0.020		487.20	0.019
	1197.59	0.019		1197.59	0.020		482.40	0.019		482.40	0.018
	1202.39	0.019		1202.39	0.019		477.60	0.019		477.60	0.018
	1207.19	[illegible]		1207.19	0.046		472.80	0.084		472.80	0.082
	1211.99	0.037		1211.99	0.045		468.00	0.080		468.00	0.077
	1216.79	[illegible]		1216.79	0.044		463.20	0.071		463.20	0.067
	1221.59	0.036		1221.59	0.043		458.40	0.064		458.40	0.060
	1226.39	0.036		1226.39	0.042		453.60	0.057		453.60	0.053
	1231.19	[illegible]		1231.19	0.039		448.80	0.050		448.80	0.047
	1235.99	0.033		1235.99	0.036		444.00	0.039		444.00	0.040
	1240.79	0.032		1240.79	0.036		439.20	0.032		439.20	0.030
	1245.59	0.031		1245.59	0.035		434.40	0.027		434.40	0.025
	1250.39	0.030		1250.39	0.033		429.60	0.023		429.60	0.022
	1255.19	0.029		1255.19	0.032		424.80	0.020		424.80	0.020
	1259.99	0.029		1259.99	0.031		420.00	0.019		420.00	0.018

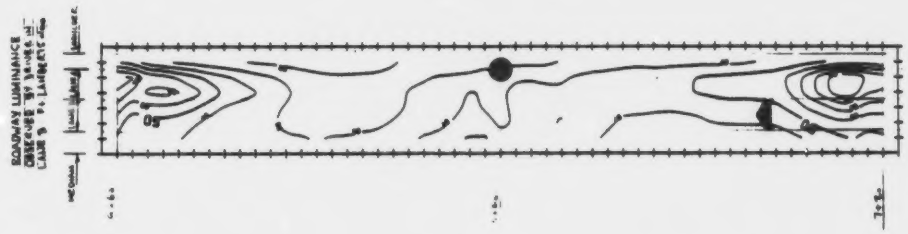
INDIVIDUAL DVB RESULTS

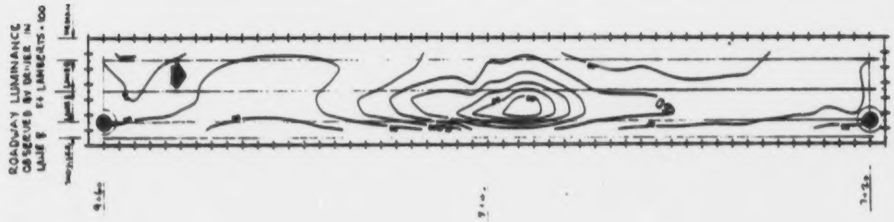
	LANE NO. 1	LANE NO. 2	LANE NO. 3	LANE NO. 4
DVB AVG	0.0283	0.0314	0.0311	0.0288
DVB MAX	0.0699	0.0674	0.0844	0.0819
DVB MAX AVG *	0.0538	0.0643	0.0638	0.0608
LUM AVG FOR LANE	0.4559	0.4064	0.3931	0.4241
DVB AVG/LUM AVG	0.0621	0.0772	0.0790	0.0680
DVB MAX AVG/LUM AVG	0.1180	0.1583	0.1624	0.1433

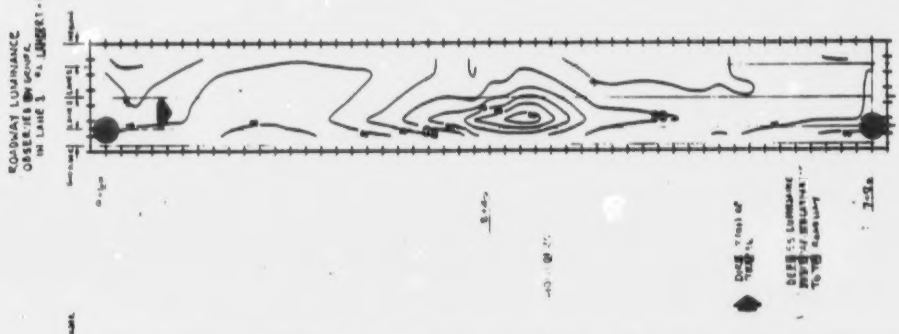
* DVB MAX AVG - IS THE MAXIMUM VALUE OF THE MOVING AVERAGE WITHIN AN INTERVAL OF 33 FEET OR 10 METRES.

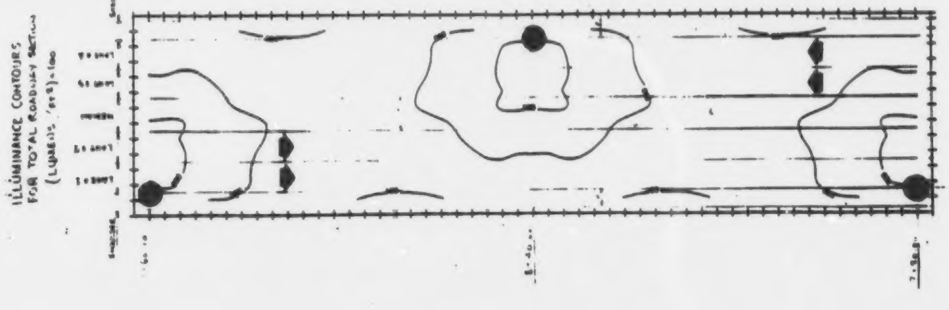
B.2/ Graphical Illustration of Calculation











APPENDIX C/

C.1/ Description of Luminaire Types

C.2/ Pavement Classification

I TRACE CARD

CONTENT IN INDEX FILE (I) FOR ILLUMINATION TABLES

LAMP CODE	MANUFACTURER	REFERENCE NO	DESCRIPTION	I.E.S. TYPE	INIT. LUMENS	LIFE SPAN
1	ITT	26018	400W CLEAR MERCURY	N-C	20600	24000
2	ITT	246	400W C.M.(30 DEG TILT) *	II	20600	24000
3	ITT	246	400W C.M.(45 DEG TILT) *	II	20600	24000
4	ITT	6236	250W H.P.S.(30 DEG TILT) *	II	25500	24000
5	ITT	6236	250W H.P.S.(45 DEG TILT) *	II	25500	24000
6	ITT	6246	400W H.P.S.(30 DEG TILT) *	II	50000	24000
7	ITT	25-61	250W H.P.S.	III-M-C	25500	24000
8	ITT	25-39	400W H.P.S.	III-M-C	50000	24000
9	ITT	25-38	250W H.P.S.	II-M-C	25500	24000
10	ITT	P2122	150W H.P.S. - LU 150/55	III-S-C	16000	24000
11	ITT	P2139M	400W H.P.S. - LU 310	III-M-C	37000	24000
12	ITT	P2138M	400W H.P.S.	II-M-C	37000	24000
13	ITT	P2145	400W H.P.S.	III-LSC	50000	24000
14	ITT	2012	250W H.P.S. WIDE-LITE HOR	III-M-SC	16000	24000
15	ITT	2015	250W H.P.S. WIDE-LITE HOR	II-M-SC	16000	24000
16	ITT	2030	250W H.P.S. WIDE-LITE HOR	III-M-SC	16000	24000
17	ITT	2031	250W H.P.S. WIDE-LITE HOR	III-S-C	16000	24000
18	ITT	2033	250W H.P.S. WIDE-LITE HOR	III-M-C	16000	24000
19	ITT	P2389M	400W H.P.S.-FLAT GLASS LEN	III-M-C	50000	24000
20	ITT (WIDELITE)	P3238	1000W H.P.S.-400W TEST LAMP	II-M-S-C	50000	24000
21	ITT (WIDELITE)	P3237	1000W H.P.S.-450W TEST LAMP	III-M-SC	50000	24000
22	ITT (WIDELITE)	0007	400W H.P.S.	IIIM-SC	50000	24000
23	ITT (WIDELITE)	0016	400W H.P.S.	II-M-SC	50000	24000
24	ITT (WIDELITE)	2036	400W H.P.S.	II-M-C	50000	24000
25	ITT (WIDELITE)	2142	250W H.P.S.	III-M-SC	27500	24000
26	ITT (WIDELITE)	2045	250W H.P.S.	II-M-SC	27500	24000
27	ITT (WIDELITE)	26	250W H.P.S.	IV-M-SC	27500	24000
28	ITT (WIDELITE)	2034	150W H.P.S.	III-M-C	16000	24000
29	ITT (WIDELITE)	2035	150W H.P.S.	II-M-SC	16000	24000
30	ITT (WIDELITE)	P0010	400W H.P.S. - HORIZONTAL	III-M-C	50000	24000
31	MCGRAW EDISON	365-157	250W H.P.S. CLEAR	II-M-C	25500	24000
32	MCGRAW EDISON	359-319	400W H.P.S.	III-M-C	50000	24000
33	MCGRAW EDISON	359-322	250W H.P.S.	III-M-C	25500	24000
34	MCGRAW EDISON	359-321	250W H.P.S.	II-M-C	25500	24000
35	MCGRAW EDISON	365-173	250W H.P.S.	II-M-C	25500	24000
61	PHILIPS	829	135W L.P.S. CANTENARY *	II	21500	16000
62	PHILIPS	829	180W L.P.S. CANTENARY *	II	33000	18000
63	PHILIPS	833	180W L.P.S.	IV-M-C	33000	18000
64	PHILIPS	251/1	135W L.P.S.		22500	18000
65	PHILIPS	XRP 826	SOX 557LPS7ITL24563		6000	18000
91	POWERLITE	22989	400W CLEAR MERCURY	III-M-C	20200	24000
92	POWERLITE	22990	400W CLEAR MERCURY	II-M-C	20200	24000
93	POWERLITE	23134	400W CLEAR MERCURY	II-S-C	21750	24000
94	POWERLITE	23454	400W CLEAR MERCURY	II-M-C	20200	24000
95	POWERLITE	430630	400W CLEAR MERCURY	III-M-C	21000	24000
96	POWERLITE	24117	700W CLEAR MERCURY	III-M-C	38000	24000
97	POWERLITE	300637	700W CLEAR MERCURY	III-M-C	36500	24000
98	POWERLITE	27814	150W H.P.S.	II-M-SC	16000	24000
99	POWERLITE	26024	250W H.P.S.(45 DEG TILT)		25500	24000
100	POWERLITE	ITL 21493	330W H.P.S.(PD#400/PHIL330)	III-S-S	30000	16000
101	POWERLITE	23520	400W H.P.S.	II-M-C	50000	24000
102	POWERLITE	23521	400W H.P.S.	II-S-C	50000	24000
103	POWERLITE	26023	400W H.P.S.(45 DEG TILT)		50000	24000
104	POWERLITE	23518	400W H.P.S.	III-M-C	50000	24000
105	POWERLITE	25696	1000W H.P.S.	III-M-C	130000	24000
106	POWERLITE	23453	400W METAL HALIDE	II-L-S	32000	15000

4.

TITLE CARD

```
CONTENT IN INDEX FILE (1) FOR ILLUMINATION TABLES
LAMP CODE   MANUFACTURER      REFERENCE NO           DESCRIPTION                 I.E.S. TYPE     INIT. LUMENS  LIFE SPAN  L
  107      POWERLITE         23206         400W METAL HALIDE                 III-M-C           32000        15000
  108      POWERLITE         23208         400W METAL HALIDE                 II-M-C            32000        15000
  109      POWERLITE         23209         400W METAL HALIDE                 II-S-C            32000        15000
  110      POWERLITE         23374         1000W METAL HALIDE                III-M-C           90000        10000
  111      POWERLITE         4849          400W H.P.S.-FLAT GLS CLEAR        II-S-C            20000        24000
  115      POWERLITE         4695          250W H.P.S.-FLAT GLS CLEAR        II-S-C            15000        24000
  121      THORN             ALPHA 3       400W MERC-FLUORESCENT             S-C               21500        24000
  131      MOLDCAST          20357         400W H.P.S.-SITE MODULLA          III-S-SC          50000        24000
  132      MOLDCAST          20358         400W H.P.S.-SITE MODULLA          III-S-SC          50000        24000
  133      MOLDCAST          22215         400W H.P.S. - PERICLINE           V                 50000        24000
  151      WESTINGHOUSE      619120        400W CLEAR MERCURY *              III-M-C           21000        24000
  152      WESTINGHOUSE      630465        400W CLEAR MERCURY                II-S-C            21000        24000
  153      WESTINGHOUSE      630569        400W CLEAR MERCURY                III-M-SC          21000        24000
  154      WESTINGHOUSE      630510        400W CLEAR MERCURY                III-M-S           21000        24000
  155      WESTINGHOUSE      619320        700W C.M.(5 DEG TILT) *           IV-L-C            38000        24000
  157      WESTINGHOUSE      630421        1000W CLEAR MERCURY               IV-M-C            57500        24000
  158      WESTINGHOUSE      630401        1000W CLEAR MERCURY               III-M-C           57500        24000
  159      WESTINGHOUSE      672212        150W H.P.S.                       II-M-C            16000        24000
  160      WESTINGHOUSE      630452        400W H.P.S.                       III-M-S           47000        24000
  161      WESTINGHOUSE      630407        400W H.P.S.                       II-S-S            47000        24000
  162      WESTINGHOUSE      630406        400W H.P.S.                       III-S-C           47000        24000
  163      WESTINGHOUSE      630678        1000W H.P.S.                      IV-M-SC          140000        24000
  164      WESTINGHOUSE      630750        1000W METAL HALIDE                II-M-C            90000        10000
  165      WESTINGHOUSE      630404        1000W METAL HALIDE                III-M-SC          90000        10000
  166      WESTINGHOUSE      630405        1000W METAL HALIDE                III-M-C           90000        10000
  167      WESTINGHOUSE      630642        400W H.P.S.                       I-M-C             47000        24000
  168      WESTINGHOUSE      630511        400W CLEAR MERCURY                IV-M-S            22100        24000
  169      WESTINGHOUSE      630422        1000W CLEAR MERCURY               III-S-SC          55500        24000
  171      WESTINGHOUSE      630502        250W H.P.S.                       III-M-SC          25500        24000
  172      WESTINGHOUSE      630504        250W H.P.S.                       III-M-SC          25500        24000
  173      WESTINGHOUSE      630505        250W H.P.S.                       II-M-SC           25500        24000
  174      WESTINGHOUSE      630454        175W CLEAR MERCURY                III-L-S            7500        24000
  175      WESTINGHOUSE      312450        250W H.P.S.                       III-M-C           25500        24000
  176      WESTINGHOUSE      312430        250W H.P.S.                       II-M-C            25500        24000
  177      WESTINGHOUSE      EHL3992       250W H.P.S.                       II-M-C            22000        24000
  178      WESTINGHOUSE      32411         250W H.P.S.                       III-M-C           22000        24000
  179      WESTINGHOUSE      30511         400W H.P.S.   UV-25               III-M-S           50000        24000
  180      WESTINGHOUSE      31370         400W H.P.S.   UV-25               III-M-S           50000        24000
  181      WESTINGHOUSE      31596         250W H.P.S.   UV-15               II-M-C            16000        24000
  182      WESTINGHOUSE      31602         250W H.P.S.   UV-15               II-M-C             5600        24000
  183      WESTINGHOUSE      31605         250W H.P.S.   UV-15               II-M-S             5600        24000
  184      WESTINGHOUSE      31607         250W H.P.S.   UV-15               II-M-S            16000        24000
  185      WESTINGHOUSE      31608         250W H.P.S.   UV-15               II-M-S             9500        24000
  186      WESTINGHOUSE      31609         250W H.P.S.   UV-15               II-M-C             9500        24000
  187      WESTINGHOUSE      31610         250W H.P.S.   UV-15               II-M-C            27500        24000
  188      WESTINGHOUSE      31613         250W H.P.S.   UV-15               III-M-C           27500        24000
  189      WESTINGHOUSE      31978         400W H.P.S.   UV-25               II-M-C            50000        24000
  190      WESTINGHOUSE      34016         400W H.P.S.   UV-25               II-M-S            50000        24000
  211      ITT (WIDELITE)    P0009         400W H.P.S.-HORIZONTAL            II-M-C            50000        24000
  212      ITT (WIDELITE)    P2045         250W H.P.S.-HORIZONTAL            II-M-SC           27500        24000
  213      ITT (WIDELITE)    P2142         250W H.P.S.-HORIZONTAL            III-M-SC          27500        24000
  271      MIC RESEARCH                    ZERO INTENSITY ARRAY *                                  0            0
  272      MIC ISO-CURVE     123456789     UNIT INTENSITY                                          0            0
  273      ANY               FOR EXAMPLE   100W INCNDSNT ILUMS ONLY *  ANY                         0         2500
  274      ANY               FOR EXAMPLE   100W FLORSCNT ILUMS ONLY *  ANY                         0        15000
  275      GTE SYLVANIA      LU818701      150W H.P.S.                       II-M              16000        24000
```

C.2/ Pavement Classifications

II Recommended Design Values for Southern Ontario Pavements

COMPOSITION	R or N CLASS	BRIGHTNESS
steel slag, open grade	R2, N3, R3	Q0 = 0.06
traprock, open grade	R3, R4	Q0 = 0.07
blend of igneous & lime, open grade	N3	Q0 = 0.09
limestone, open grade	N3	Q0 = 0.10
steel slag, dense friction course	R4 or N4	Q0 = 0.075
blast furnace slag, dense friction course	R2 or N2	Q0 = 0.075
traprock, dense friction course	R2, N3, R3	Q0 = 0.065
blend of igneous & lime dense f.c.	R3 or N3	Q0 = 0.085
limestone, dense friction course	R2, N2, R3, N3	Q0 = 0.10
concrete limestone plain	R3 or N3 old: R4	Q0 = 0.12
concrete limestone lateral grooves	R3 or N3 old: R4	Q0 = 0.095

NOTE: The higher specularity class is valid for older pavements.

CONTENT IN INDEX FILE (1) FOR REFLECTANCE TABLES

REFL. CODE	NAME	DESCRIPTION	Q0
301	R-1	Q0 = 0.10	0.10
302	R-2	Q0 = 0.07	0.07
303	R-3	Q0 = 0.07	0.07
304	R-4	Q0 = 0.08	0.08
305	N-1	Q0 = 0.10	0.10
306	N-2	Q0 = 0.07	0.07
307	N-3	Q0 = 0.07	0.07
308	N-4	Q0 = 0.08	0.08

APPENDIX D

MAIN AND SUBROUTINES PROGRAM FLOWCHARTS AND PROGRAM LISTINGS OF FOLLOWING ROUTINES:

D.1/ Main Routine Flowchart and Program Listing

D.2/ INPUT and INPUT1 Routines Flowcharts and Programs Listing

D.3/ COORD and COORD1 Routines Flowcharts and Programs Listing

D.4/ LIGHT Subroutine Flowchart and Program Listing

D.5/ OUTPUT Subroutine Flowchart and Program Listing

D.6/ GAMPHI Subroutine Flowchart and Program Listing

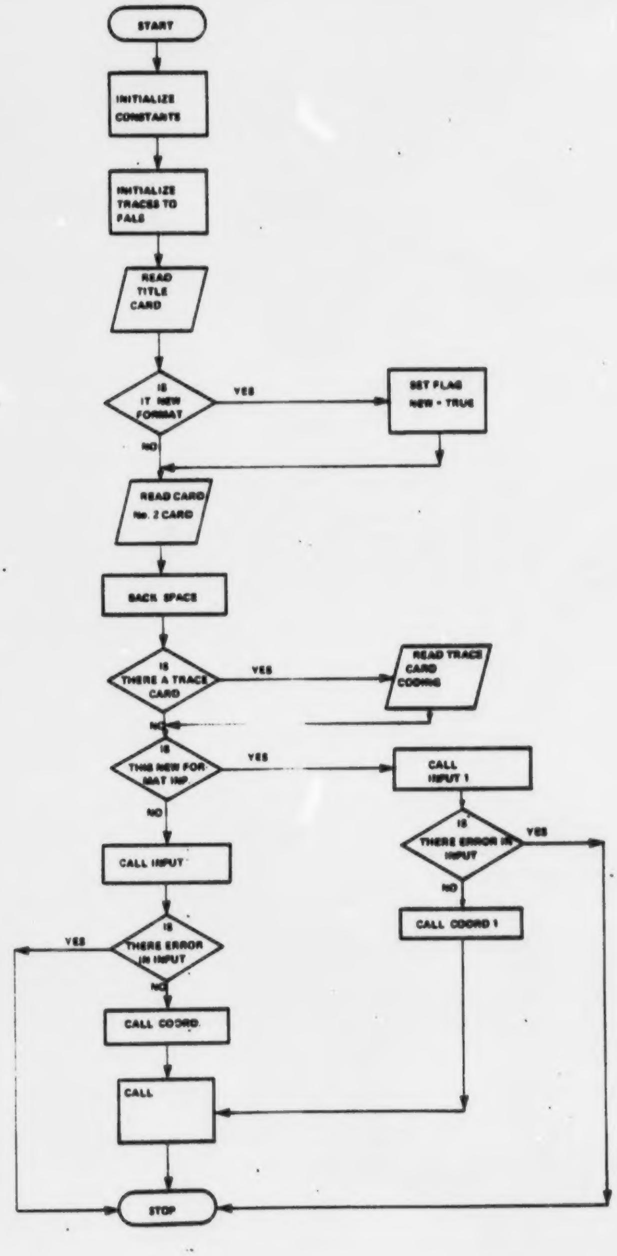
D.7/ BETGAM Subroutine Flowchart and Program Listing

D.8/ AVMAMI Subroutine Flowchart and Program Listing

D.9/ AVG1, AVG2 and AVCALC Subroutines Program Listing

D.1/ Main Routine Flowchart and Program Listing

The primary function of the main routine is to control the overall execution of the program. This routine reads the header card which distinquishes between the 'new' and 'old' version of the program. The trace option for debugging has also been introduced.

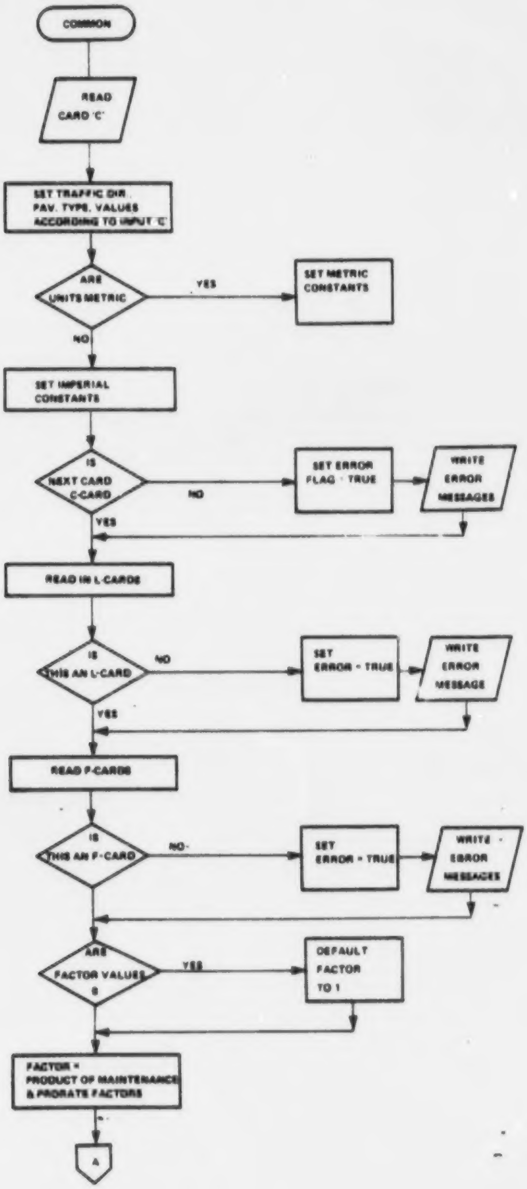


```
C     ILUM 1  -----  1975
C *** THIS IS THE MAIN ROUTINE WHICH CONTROLS MOST CALL STATEMENTS
C
C *** COMMON /ONE/ CONTAINS INPUT DATA
C *** COMMON /TWO/ CONTAINS COORDINATE VARIABLES FOR GRID POINTS,
C                  LUMINAIRE POSITIONS, & DRIVER POSITIONS.
C
C *** EP - ILLUMINATION OF GRID POINTS BETWEEN TWO LAMP POLES.
C          DIMENSION DEPENDS ON NY,NC
C *** REF - REFLECTANCE FROM GRID POINTS TO EACH DRIVER POSITION.
C          DIMENSION DEPENDS ON NY,NX
C *** REFLEC - REFLECTANCE VALUES IN R-TABLE. TABLE IS STORED BY ROWS,
C          ONE TABLE PER RECORD.
C *** DVB - DISABILITY VEILING BRIGHTNESS.
C          DIMENSION DEPENDS ON NY,NC
C *** DIST - LIGHT DISTRIBUTION VALUE FROM MANUFACTURER.
C          TABLE STORED BY COLUMNS.
C *** NY=NO. OF GRID POINTS IN BETWEEN TWO LAMP POLES.
C     NC=NO. OF DRIVER POSITION IN ONE LANE
C     NLU( )=NO. OF LUMINAIRES IN EACH ROW, 4 ROWS ALTOGETHER.
C     NX=MAX NO. OF COLUMNS OF GRID POINTS ACROSS THE ROAD
C     X,Y= COORDINATES FOR GRID POINTS(DIMENSIONS DEPENDS ON NX,NY)
C     XLC,YLC= COORDINATES FOR DRIVER, DIMENSIONS DEPENDS ON NY,NC
C     XLU,YLU,ZLU=COORDINATES FOR LUMINAIRES, MAX. 26 LUMINAIRES/ROW.
C     TYPE - LUMINAIRE TYPE,USED AS ASSOCIATE VARIABLE IN FILE 11
C *** PAVTYE - PAVEMENT TYPE,USED AS ASSOCIATE VARIABLE IN FILE 12
C     FOR OTHER VARIABLES, CHECK INPUT SHEET.
C     **********************************************************
      LOGICAL*1 TRACE(3)
      COMMON /CONST/ DETORA, PI, HAFPI, PI10, HTDRIV, FM90, ANGLIM,
     1         TYPNO, NMANU, NOPN, SILMP, TRACE
C
      LOGICAL NEW, SILMP
      DIMENSION TITLE(19)
C
      DATA IES/'IES '/,TRAC/'TRAC'/
C
      REWIND 80
C
C...INITIALIZE CONSTANTS AND SET "TRACES" = .FALSE.
C
      DO 10 I=1,3
   10 TRACE(I) = .FALSE.
      NEW = .FALSE.
      PI = 3.141593
      HAFPI = PI*0.5
      TYPNO = 15
      NMANU = 1
      DETORA = PI/180.
C...READ TITLE CARD AND DETERMINE WHICH METHOD IS TO BE USED
C
      READ(5,800,END=9998) ID, TITLE
  800 FORMAT(A4,19A4)
      IF(ID .EQ. IES) NEW = .TRUE.
C
C...READ SECOND: IF TRACE CARD READ IT ACCORDINGLY
C
      READ(5,900) CARD
  900 FORMAT(A4)
      BACKSPACE 5
      IF( CARD .NE. TRAC) GOTO 805
      READ(5,901) TRACE
  901 FORMAT(6X,3L1)
C
  805 IF( NEW ) GO TO 820
C
C...ORIGINAL METHOD
C
      WRITE(6,810) TITLE
  810 FORMAT('1',18A4,/)
      CALL INPUT(&9998)
      CALL COORD
      GO TO 840
C
C...NEW IES METHOD
C
  820 WRITE(6,830) ID, TITLE
  830 FORMAT(T6,'ILLUMINANCE,LUMINANCE & DISABILITY VEILING BRIGHTNESS',
     1T60,'ACCORDING TO THE -',A3,'- STANDARDS'/,T5,19A4)
      CALL INPUT1(&9998)
      CALL COORD1
C
C...COMMON ROUTINES
C
  840 CALL LIGHT(NEW)
      CALL OUTPUT(NEW,&9998)
      CALL PLOTIL
      CALL PLOT90
 9998 STOP
      END
```

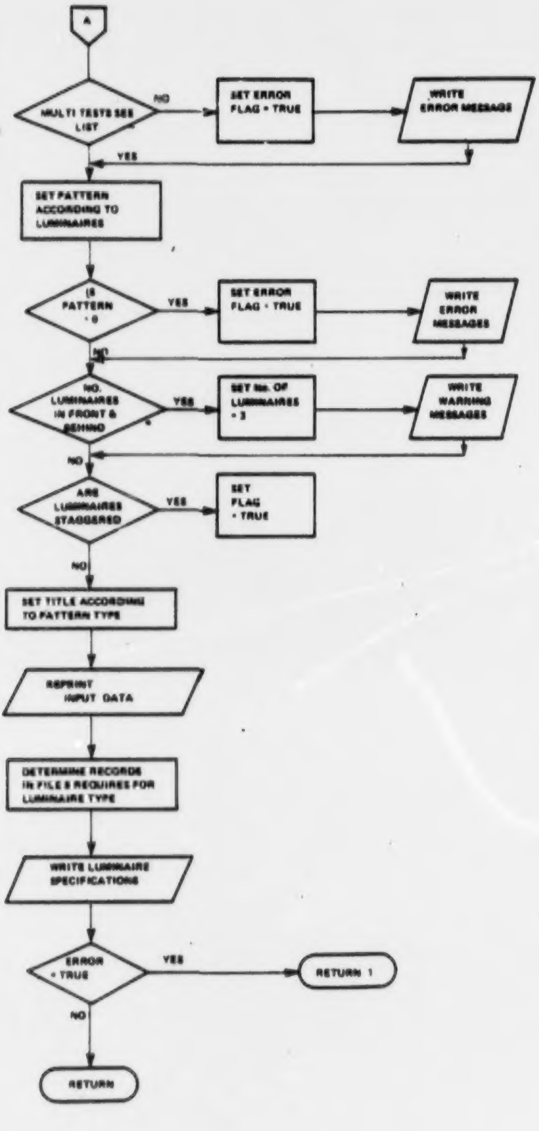
D.2/ INPUT and INPUT1 Routines Flowchart and Programs Listing

The function of these routines is to read in all input data cards in their respective formats. Appropriate checks are then carried out to avoid meaningless calculations and to ensure that the assumptions made by the designer have not been violated and that the input data does not provide conflicting statements.

All input data is reprinted and when all the tests are passed, execution begins. Otherwise, program execution is terminated.



1. No. OF STRIPS/SHOULDER ≤ 2
2. No. OF LANES/ROADWAY ≤ 4
3. No. OF STRIPS/LANE = 2 OR 4
4. No. OF DIVISIONS BETWEEN LUMINAIRES ≤ 60
5. DVS ANGLE ≤ 30° 00' 00"
6. No. OF LUMINAIRES IN FRONT AND BEHIND THE STUDY AREA ≤ 12 ≤ 13
7. No. OF STRIPS/SHOULDER ≥ 0
8. No. OF STRIPS/LANE ≥ 0



```
      SUBROUTINE INPUT(*)
C
C     THIS ROUTINE READS,EDITS, AND REPRINTS INPUT DATA
C
C     ******************************************************************
C
      COMMON /ONE/  DISTP,      DVBANG(3),FMAIN(4), HT(4),      KDIV,
     1              LANE(2),    LOSTAT(4),MDIV(2),  NLR(4),     NLUA,
     2              NSTRIP,     OFFSET(4),PATERN,   PAVTYE,     QO,
     3              ROWAY(2),   REV,      TYPE(4),  UNIT,       USTAT(4),
     4              WMED,       LOCODE,   MANUF,    RADIUS,     ICURVE,
     5              L,          IRINDX(4),EPSLN,    UPHILL,     WLANE(2,4),
     6              WSHOLD(2),MEDIV,      ROWD(2)
C
      COMMON /CONST/DETORA, PI, HAFPI, PI10, HTDRIV, FM90, ANGLIM,
     1              TYPNO, NMANU, NOPN, SILMP,TRACE
      LOGICAL*1 TRACE(3)
C
      DIMENSION ITEMP(4), IA(25), FFMAIN(4), PRORAT(4)
      DIMENSION FM(2), TRAFDI(2), PAVE(8)
      DIMENSION NSEQ(50), NREC(4), A(25)
      DIMENSION PATLIN(7), LR(2), AOSTAT(4), OUTLIN(5)
C
      EQUIVALENCE (NO,SNGL,PATLIN(1)), (MED,PATLIN(3)), (ARR,PATLIN(5))
      EQUIVALENCE (CONSID,OUTLIN(2))
C
      INTEGER*4  TYPE, PATERN, PAT, PAVTYE, RECODE, TYPEK4, C, D, E
      REAL       LL, MM
      REAL*8     MED, ARR, MED1, ARR1, ARR2, TWOR, THREER, FOURR, NO
      COMPLEX*16 SNGL, CONSID, SNGL1, CONSD1
      LOGICAL    ERROR, REV, UPHILL, SILMP, STGSWT
C
      DATA  FACT/'F'/, RR/'R'/, DD/'D'/
      DATA  CC/'C'/, LL/'L'/, FF/'F'/, MM/'M'/, PAT/0/
      DATA  FM/' M',' FT'/, TRAFDI/'TWO','ONE'/, BLANK/' '/
      DATA  PAVE/'(R1)','(R2)','(R3)','(R4)','(N1)','(N2)',
     1           '(N3)','(N4)'/,LR/'(L.','(R.'/
      DATA  SNGL1/'  SINGLE ROW'/, CONSD1/'R.S. CONSIDERED)'/
      DATA  MED1/' MEDIAN'/, ARR1/'OPPOSITE'/, ARR2/'STAGGERE'/
      DATA  TWOR/' 2 ROWS'/, THREER/' 3 ROWS'/, FOURR/' 4 ROWS'/
C
      DEFINE FILE 8(350,60,U,I1)
      DEFINE FILE 11(300,1102,U,TYPEK4)
      DEFINE FILE 12(50,600,U,PAVTYE)
C
C
      ERROR  = .FALSE.
      REV    = .FALSE.
      UPHILL = .FALSE.
      SILMP  = .FALSE.
C
C  READ ROAD DATA (C-CARD)
C  -----------------------
C
      READ(5,850)    CARD,      UNIT,      PAVTYE,   MDIV(1),  LANE(1),
     1               ROWAY(1),  WMED,      ROWAY(2), LANE(2),  MDIV(2),
     2               DISTP,     NSTRIP,    KDIV,     NLUA,     DVBANG,
     3               QO,        RECODE,    LOCODE,   C,        D,
     4               EPSLN,     E,         RADIUS,   ICURVE
  850 FORMAT(A1,1X,A1,2X,I3,4X,2I2,3F5.2,2I2,F5.2,I1,2I2,3F2.0,F5.4,
     1  4I1,F4.2,I1,F6.0,I2)
C
      IF(TRACE(1))
     1 WRITE(5,9000) CARD,      UNIT,      PAVTYE,   MDIV(1),  LANE(1),
     2               ROWAY(1),  WMED,      ROWAY(2), LANE(2),  MDIV(2),
     3               DISTP,     NSTRIP,    KDIV,     NLUA,     DVBANG,
     4               QO,        RECODE,    LOCODE,   C,        D,
     5               EPSLN,     E,         RADIUS,   ICURVE
 9000 FORMAT(/'  C-CARD REPRINT -- ',A1,1X,A1,2X,I3,4X,2I2,3F6.2,
     1    F6.2,I1,2I2,3F3.0,F6.4,4I1,F5.2,I1,F7.0,I2)
C
C
C*********CURVES********************CURVES********************CURVES*********
C
      IF((IABS(ICURVE).EQ.1) .OR. (ICURVE.EQ.0)) GO TO 11
      WRITE(6,606)
      ICURVE = 0
      RADIUS = 0
   11 IF((.NOT.(ICURVE.EQ.0 .OR. ICURVE.EQ.1 .OR. ICURVE.EQ.-1))
     1 .OR. (RADIUS.GT.0. .AND. NLUA*DISTP.GT.RADIUS*PI)
     2 .OR. RADIUS.LT.0.) GO TO 10
      GO TO 20
   10 ERROR = .TRUE.
      WRITE(6,603)
   20 IF(ICURVE .EQ. 1) WRITE(6,600)
      IF(ICURVE .EQ. -1) WRITE(6,601)
```

```
C
  600 FORMAT('0',56X,'ROAD CURVES TO THE RIGHT'/T57,24('-'))
  601 FORMAT('0',56X,'ROAD CURVES TO THE LEFT'/T57,23('-'))
  602 FORMAT('0',52X,'RADIUS OF CURVATURE = ',F6.0,A4)
  603 FORMAT(1X,'***FATAL*** INPUT ERROR INVOLVING CURVE SPECIFICATIONS'
     1)
  606 FORMAT('0','**WARNING** CURVE DIRECTION ENTERED IMPROPERLY ',
     1 'ENTRY HAS BEEN CHANGED TO READ NO CURVATURE')
C
C********CURVES**********************CURVES********************CURVES*********
      RECODE = RECODE + 1
C
C...IF RECODE = 2 THEN TRAFFIC IS IN 2 DIRETIONS
C
      IF(RECODE .EQ. 2) REV = .TRUE.
C
C...UNITS DEFAULTED TO METRIC
C
      IF(UNIT .EQ. BLANK) UNIT = MM
      IPAVE = PAVTYE - 300
C.............................................................................
      IF(E .EQ. 1) SILMP = .TRUE.
      IF(D .EQ. 1) UPHILL = .TRUE.
      IF(EPSLN .LT. 0.0) WRITE(6,891)
      EPSLN = ABS(EPSLN)
      EPSLN1 = EPSLN*PI/180.
      DISTPR = DISTP/COS(EPSLN1)
      IF(EPSLN .LT. 80) GO TO 90
      WRITE(6,892)
      ERROR = .TRUE.
   90 CONTINUE
C.............................................................................
      Q00 = Q0
      ANGLIM = (DVBANG(1)+DVBANG(2)/60.+DVBANG(3)/3600.)*DETORA
      IF(ANGLIM .GT. 0.0) GO TO 100
C
C...DEFAULT DVB ANGLE TO 20 DEGREES
C
      DVBANG(1) = 20.
      ANGLIM = 20.*DETORA
C
  100 IF(UNIT .NE. FF) GO TO 120
C
C...ASSIGN IMPERIAL CONSTANTS
C
      MF = 2
      HTDRIV = 5.
      PI10 = PI*10.
      FM90 = 300.
      Q0 = Q0*PI
      GO TO 140
C
C...ASSIGN METRIC CONSTANTS
C
  120 MF = 1
      HTDRIV = 1.5
      PI10 = 10.
      FM90 = 90.
C
  140 IF(CARD .EQ. CC) GO TO 260
      WRITE(6,860) CC
      ERROR = .TRUE.
C
C  READ LUMINAIRE DATA (L-CARD)
C  ----------------------------
C
C
  260 READ(5,870)   CARD,     PATERN,   (NLR(K),TYPE(K),HT(K),
     1               OFFSET(K),LUSTAT(K),USTAT(K),K=1,4)
C
      IF(TRACE(1)) WRITE(6,9001) CARD,PATERN,(NLR(K),TYPE(K),HT(K),
     1               OFFSET(K),LUSTAT(K),USTAT(K),K=1,4)
 9001 FORMAT(' L-CARD REPRINT — ',A1,1X,I1,1X,4(I1,I3,F5.2,F4.1,
     *               I3,F3.1))
C
      IF(CARD .EQ. LL) GO TO 270
      WRITE(6,860) LL
      ERROR = .TRUE.
C
C
C  READ MAINTENANCE AND PRORATING FACTORS CARD (F-CARD)
C  ----------------------------------------------------
C
  270 READ(5,875) CARD,(FMAIN(I),I=1,4),(PRORAT(I),I=1,4)
  875 FORMAT(A1,1X,8F4.3)
C
      IF(TRACE(1)) WRITE(6,9002) CARD,(FMAIN(I),I=1,4),(PRORAT(I),I=1,4)
 9002 FORMAT(' F-CARD REPRINT — ',A1,1X,8F5.3)
```

```
C
      IF(CARD .EQ. FACT) GO TO 95
      WRITE(6,860) FACT
      ERROR = .TRUE.
   95 CONTINUE
C
C...DEFAULT INPUT FACTORS TO 1.0
C
      DO 99 I=1,4
      IF(FMAIN(I) .LE. 0.) FMAIN(I) = 1.
      IF(PRORAT(I) .LE. 0.) PRORAT(I) = 1.
      FFMAIN(I) = FMAIN(I)*PRORAT(I)
   99 CONTINUE
C
C...EDIT INPUT DATA
C     LIMITS:
C          2 STRIPS ON EACH SHOULDER
C          4 LANES ON EACH ROADWAY
C          2 OR 4 STRIPS ON EACH LANE
C          90 STRIPS BETWEEN TWO LAMP POLES
C          DVH ANGLE LESS THAN 31 DEGREES
C          12 LAMPS IN FRONT AND BEHIND
C
C
      IF(MDIV(1).LE.2 .AND. MDIV(2).LE.2 .AND. LANE(1).LE.4 .AND.
     1   LANE(2).LE.4 .AND. (NSTRIP.EQ.2 .OR. NSTRIP.EQ.4) .AND.
     2   KDIV.LT.91 .AND. ((DVBANG(1).LT.30. .AND. DVBANG(2).LT.60.
     3   .AND. DVBANG(3).LT.60.) .OR. (DVBANG(1).EQ.20. .AND.
     4   DVBANG(2).EQ.0. .AND. DVBANG(3).EQ.0.)) .AND. NLUA.LE.12
     5   .AND. LANE(1).GT.0 .AND. LANE(2).GE.0  .AND. KDIV.GT.0)
     6   GO TO 280
      WRITE(6,880) CC
      ERROR = .TRUE.
C
C...CHECK PATERN TYPE WITH ROW INPUT
C
  280 IF(TYPE(1).GT.0 .OR.  TYPE(4).GT.0) PAT = 1
      IF(TYPE(1).GT.0 .AND. TYPE(4).GT.0) PAT = 2
      IF(TYPE(2).GT.0 .AND. TYPE(3).GT.0) PAT = 3
      IF(TYPE(1).GT.0 .AND. TYPE(2).GT.0 .AND. TYPE(3).GT.0) PAT = 5
      IF(TYPE(4).GT.0 .AND. TYPE(2).GT.0 .AND. TYPE(3).GT.0) PAT = 6
      IF(TYPE(1).GT.0 .AND. TYPE(2).GT.0 .AND. TYPE(3).GT.0 .AND.
     1    TYPE(4).GT.0) PAT = 4
      IF(PAT .NE. 0) GO TO 290
C
      WRITE(6,880) LL
      ERROR = .TRUE.
  290 IF(PATERN .EQ. PAT) GO TO 295
      PATERN = PAT
      WRITE(6,890)
C
C...MIN. NO. OF INTERVALS OF LIGHT POLE DISTANCE IS 3 IN FRONT
C    AND REAR OF POINT UNDER EXAMINATION.
C
  295 IF(NLUA .GE. 0) GO TO 296
      NLUA = 3
      WRITE(6,895)
  895 FORMAT('***WARNING*** NO. OF LUMINAIRE INTERVALS IS CHANGED TO 3')
C
C.......................................................................
  296 IF(EPSLN .EQ. 0.) GO TO 300
      IF(UPHILL) WRITE(6,893)
      IF(.NOT.UPHILL) WRITE(6,894)
C.......................................................................
C
  300 STGSWT = .FALSE.
      DO 148 I=1,4
  148 AUSTAT(I) = LUSTAT(I)*100 + USTAT(I)
      IF(AUSTAT(1).NE.AUSTAT(2) .OR. AUSTAT(1).NE.AUSTAT(4))
    1 STGSWT = .TRUE.
      DO 150 I=1,7
  150 PATLIN(I) = BLANK
      CONSID = BLANK
      SIDE = BLANK
C
C...SET DESCRIPTIONS ACCORDINGLY
C
      IF(PATERN .NE. 1) GO TO 155
      SNGL = SNGL1
      GO TO 180
C
  155 IF(PATERN .NE. 2) GO TO 160
      NO = TWOW
      MED = ARR1
      IF(STGSWT) MED = ARR2
      IF(STGSWT) PATLIN(5) = DD
      GO TO 180
```

```
C
  160 MED = MED1
      ARR = ARR1
      IF(STGSWT) ARR = ARR2
      IF(STGSWT) PATLIN(7) = DD
C
      GO TO (180,180,165,170,175,175) ,PATERN
  165 NO = TWOR
      GO TO 180
  170 NO = FOURR
      GO TO 180
  175 NO = THREER
      CONSID = CONSD1
      OUTLIN(1) = LR(1)
      IF(PATERN .EQ. 6) OUTLIN(1) = LR(2)
C
C
C     REPRINT INPUT DATA
C     ------------------
C
  180 WRITE(6,900)
      IF(UNIT .EQ. FF) GO TO 301
      WRITE(6,901)
      GO TO 302
  301 WRITE(6,902)
C
C
  302 IF(ICURVE .NE. 0) WRITE(6,602) RADIUS, FM(MF)
C=======> WRITE THE RADIUS OF CURVATURE
C
      WRITE(6,903) TYPE, HT, OFFSET, (LUSTAT(K),USTAT(K),K=1,4)
      WRITE(6,904) PATLIN, OUTLIN
      IF(EPSLN .EQ. 0) WRITE(6,905) DISTP
      IF(EPSLN .NE. 0) WRITE(6,906) DISTP,DISTPR
      WRITE(6,907) LANE, MDIV(1), RDWAY(1), FM(MF), WMED,
     1 RDWAY(2), FM(MF), MDIV(2), FM(MF)
C
  860 FORMAT(' ***FATAL*** WRONG CARD SEQUENCE-CARD ',A1)
  870 FORMAT(A1,1X,I1,1X,4(I1,I3,F5.2,F4.1,I3,F3.1))
  880 FORMAT(' ***FATAL***WRONG INPUT DATA IN CARD ',A1)
  890 FORMAT(' PATTERN NO. RE-ASSIGNED ACCORDING TO LUMINAIRES GIVEN ' )
C.........................................................................
  891 FORMAT(' ***WARNING*** ROAD ANGLE INPUTTED AS NEGATIVE QUANTITY'
     1       /T14,'HAS BEEN CONVERTED TO POSITIVE EQUIVALENT.')
  892 FORMAT(' ***FATAL*** ROAD ANGLE INPUT TOO HIGH')
  893 FORMAT(/T6,'*** THIS PROGRAM IS FOR AN INCLINED ROAD SURFACE.'
     1       /T6,'--- ---- ------- -- --- -- -------- ---- --------'
     1       //T6,'THE ROAD SLOPES UP IN THE DIRECTION OF THE ',
     1       'TRAFFIC FLOW ON THE RIGHT HAND SIDE OF THE ROADWAY.')
  894 FORMAT(/T6,'*** THIS PROGRAM IS FOR AN INCLINED ROAD SURFACE.'
     1       /T6,'--- ---- ------- -- --- -- -------- ---- --------'
     1       //T6,'THE ROAD SLOPES DOWN IN THE DIRECTION OF THE ',
     1       'TRAFFIC FLOW ON THE RIGHT HAND SIDE OF THE ROADWAY.')
C..........................................................................
  900 FORMAT(/T6,'REPRINT INPUT DATA'/T6,'------- ----- ----' )
  901 FORMAT(/T6,'UNIT = METER ')
  902 FORMAT(/T6,'UNIT = FOOT ')
  903 FORMAT(/T6,'LUMINAIRE   ROW NUMBER',T51,'1',T71,'2',T91,'3'
     1  ,T111,'4'/T18,'TYPE',T32,4(17X,I3)/
     2  T18,'MOUNTING HEIGHT',T35,4(15X,F5.2)/
     3  T18,'OVER HANG FROM CURB',T49,F6.2,3(14X,F6.2)/
     4  T18,'FIRST LUM. POSITION',T46,4(I3,'+',F5.2,11X)// )
  904 FORMAT(T6,'PATTERN :',7A4,T44,8('-'),T71,21('-'),T111,8('-')/
     1  T17,5A4,T44,'|',T51,'0',T71,'0',T81,'|',T91,'0',T111,'0',
     2  T118,'|',2(/T44,'|',T81,'|',T118,'|'))
  905 FORMAT(T6,'DIST. BET''N LUM. POLE =',F7.2,T44,'|',T81,'|',
     1  T118,'|',2(/T44,'|',T81,'|',T118,'|'))
  906 FORMAT(T6,'DIST. BET''N LUM. POLE',T44,'|',T81,'|',T118,'|'/
     1  T10,'=',F9.2,' HORIZONTALLY',T44,'|',T81,'|',T118,'|'/T10,
     2  '=',F9.2,' ALONG ROAD SURFACE',T44,'|',T81,'|',T118,'|')
  907 FORMAT(3(T44,'|',T81,'|',T118,'|'/),T39,9('-'),T58,
     1  I2,' LANE.' ,T78,7('-'),T96,I2,' LANE.',T115,9('-')/
     2  T39,I2,' LANE |----------',F5.2,A3,'-----------|',F5.2,
     3  '|----------',F5.2,A3,'----------|',I2,' LANE'/
     4  T41,'STRIPS',T80,A3,T118,'STRIPS')
      IB1 = OVHANG(1)
      IB2 = OVHANG(2)
      IB3 = OVHANG(3)
      WRITE(6,908) PAVTYE, PAVE(IPAVE), QOD
  908 FORMAT(//T6,'PAVEMENT TYPE',T44,'= ',I6,1X,A4,
     1 /T6,'LUMINANCE CO-EFFICIENT Q0',T44,'= ',F9.4)
C
      KOUNT = 1
      WRITE(6,501)
      DO 500 I=1,4
      IF(PATERN.EQ.1 .AND. I.GT.1) GO TO 500
      IF(PATERN.EQ.2 .AND. I.GT.1 .AND. I.LT.4) GO TO 500
      IF(PATERN.EQ.3 .AND. (I.LT.2 .OR. I.GT.3)) GO TO 500
      IF(PATERN.EQ.5 .AND. I.GT.3) GO TO 500
      IF(PATERN.EQ.6 .AND. I.LT.2) GO TO 500
      IF(KOUNT .EQ. 1) GO TO 510
      IF(ABS(PRORAT(I)-1.000) .LE. 0.00001) GO TO 511
      WRITE(6,505) I, FMAIN(I), PRORAT(I), FFMAIN(I)
      GO TO 500
  511 WRITE(6,503) I, FMAIN(I)
      GO TO 500
  510 KOUNT = 2
      IF(ABS(PRORAT(I)-1.000) .LE. 0.00001) GO TO 512
      WRITE(6,504) I, FMAIN(I), PRORAT(I), FFMAIN(I)
      GO TO 500
  512 WRITE(6,502) I, FMAIN(I)
  500 CONTINUE
  501 FORMAT(/,T6,'MAINTENANCE FACTOR:')
  502 FORMAT('+',T30,'ROW NUMBER ',I1,'  = ',F9.4)
  503 FORMAT(T30,'ROW NUMBER ',I1,'  = ',F9.4)
  504 FORMAT('+',T30,'ROW NUMBER ',I1,'  = ',F9.4,
     1 ' X PRORATING FACTOR OF ',F5.2,' = ',F8.4)
  505 FORMAT(T30,'ROW NUMBER ',I1,'  = ',F9.4,
     1 ' X PRORATING FACTOR OF ',F5.2,' = ',F8.4)
C
      WRITE(6,1000) NLUA,KDIV,IB1,IB2,IB3,EPSLN,TRAFDI(RECODE),NSTRIP
 1000 FORMAT(/T6,'LUMINAIRE INTERVALS IN FRONT/REAR OF          ',
     1         /T6,'STUDY AREA FOR CALCULATION          = ',I4,
     2         /T6,'NO. OF STRIPS BETWEEN TWO LUM. POLES  = ',I4,
     3         /T6,'DVB ANGLE LIMIT                     = ',I4,
     4          ' DEG.',I3,' MIN.',I3,' SEC.',
     5         /T6,'SLOPE OF ROAD                       = ',F7.2,
     6          ' DEG',
     7         /T6,A3,' WAY TRAFFIC (TRAFFIC ON RIGHT ROADWAY INTO ',
     8          'DIAGRAM; TRAFFIC ON LEFT ROADWAY OUT OF DIAGRAM)',
     9         /T6,I2,' STRIPS PER LANE')
      IF(SILMP) WRITE(6,910)
  910 FORMAT(T6,'ONE LUMINAIRE PER ROW FOR CALCULATION.')
C
      EPSLN = EPSLN*PI/180.
      DO 98 I=1,4
      FMAIN(I) = FFMAIN(I)
   98 CONTINUE
      DO 303 I=1,50
  303 NSEQ(I) = 0
C
  320 WRITE(6,325)
  325 FORMAT(///,1X,'LUMINAIRE DESCRIPTION',//,
     1 1X,'LAMP CODE',3X,'MANUFACTURER',4X,'REFERENCE NO',5X,
     2 'DESCRIPTION',14X,'I.E.S. TYPE',6X,'INIT. LUMENS',
     3 3X,'LIFE SPAN')
C
C  SELECTION OF INDEX TABLE TO CORRESPOND WITH LUMINAIRE TYPE
C ------------------------------------------------------------
C
C
      II = 0
      DO 410 I=1,4
      IRINDX(I) = 0
  410 ITEMP(I) = TYPE(I)
C
      DO 420 I=1,4
      IF(ITEMP(I) .EQ. 0) GO TO 420
      II = II + 1
      NREC(II) = ITEMP(I)
      JL = I + 1
      DO 415 J=JL,4
      IF(ITEMP(J) .EQ. 0) GO TO 415
      IF(ITEMP(J) .EQ. ITEMP(I)) ITEMP(J) = 0
  415 CONTINUE
  420 CONTINUE
C
C
      DO 450 I=1,II
      I1 = 1
      DO 430 J=1,300
      READ(8'I1) (IA(L),L=1,18), ITBL, LUMENS, LIFESP
      IF(ITBL .EQ. NREC(I)) GO TO 435
  430 CONTINUE
  435 WRITE(6,360) (IA(L),L=1,18), LUMENS, LIFESP
  360 FORMAT(3X,A4,7X,17A4,8X,I6,8X,I6)
C
      IX = I1 - 1
      DO 440 L=1,4
      IF(TYPE(L) .EQ. ITBL) IRINDX(L) = IX
  440 CONTINUE
  450 CONTINUE
C
      IF(.NOT.ERROR) GO TO 9999
      RETURN 1
 9999 RETURN
      END
      SUBROUTINE INPUTI(*)
C
C THIS ROUTINE READS,EDITS, AND REPRINTS INPUT DATA FOR THE NEW IES
C METHOD
C ****************************************************************
C ****************************************************************
C
      COMMON /ONE/  DISTP,      DVBANG(3),FMAIN(4), HT(4),     KDIV,
     1              LANE(2),    LUSTAT(4),MDIV(2),  NLR(4),    NLUA,
     2              NSTRIP,     OFFSET(4),PATERN,   PAVTYE,    QQ,
     3              RDWAY(2),   REV,      TYPE(4),  UNIT,      USTAT(4),
     4              WMED,       LUCODE,   MANUF,    RADIUS,    ICURVE,
     5              C,          IRINDX(4),EPSLN,    UPHILL,  WLANE(2,4),
     6              WSHOLD(2),MEDIV,      RDWD(2)
C
      COMMON /CONST/DETORA, PI, HAFPI, PI10, HIDRIV, FM90, ANGLIM,
     1              TYPNO, NMANU, NOPN, SILMP, TRACE
      LOGICAL*1 TRACE(3)
C
      DIMENSION ITEMP(4), IA(25), FFMAIN(4), PRORAT(4)
      DIMENSION FM(2), TRAFDI(2), PAVE(8)
      DIMENSION NSEQ(50), NREC(4), A(25)
      DIMENSION PATLIN(7), LR(2), AUSTAT(4), OUTLIN(5)
C
      EQUIVALENCE (NO,SNGL,PATLIN(1)), (MED,PATLIN(3)), (ARR,PATLIN(5))
      EQUIVALENCE (CONSID,OUTLIN(2))
C
      INTEGER*4  TYPE, PATERN, PAT, PAVTYE, RECODE, TYPER4, C, D, E
      INTEGER*4  COUNTR
      REAL       LL, MM
      REAL*8     MED, ARR, MED1, ARR1, ARR2, TWOR, THREER, FOURR, NO
      COMPLEX*16 SNGL, CONSID, SNGL1, CONSD1
      LOGICAL    ERROR, REV, UPHILL, SILMP, STGSWT
C
      DATA  FACT/'F'/, RR/'R'/, DD/'D'/
      DATA  CL/'C'/, LL/'L'/, FF/'F'/, MM/'M'/, PAT/0/
      DATA  FM/' M',' FT'/, TRAFDI/'TWO','ONE'/, BLANK/' '/
      DATA  PAVE/'(R1)','(R2)','(R3)','(R4)','(N1)','(N2)',
     1           '(N3)','(N4)'/,LR/'(L.','(R.'/
      DATA  SNGL1/'  SINGLE ROW'/, CONSD1/'M.S. CONSIDERED)'/
      DATA  MED1/' MEDIAN'/, ARR1/'OPPOSITE'/, ARR2/'STAGGERE'/
      DATA  TWOR/' 2 ROWS'/, THREER/' 3 ROWS'/, FOURR/' 4 ROWS'/
C
      DEFINE FILE 8(350,60,U,I1)
      DEFINE FILE 11(300,1102,U,TYPER4)
      DEFINE FILE 12(50,600,U,PAVTYE)
C
C
      ERROR  = .FALSE.
      REV    = .FALSE.
      UPHILL = .FALSE.
      SILMP  = .FALSE.
C
C *** READ ROAD DATA (C-CARD)
C ----------------------------
      READ(5,850)    CARD,      UNIT,      PAVTYE,    MDIV(1),  LANE(1),
     1               WSHOLD(1),(WLANE(1,J),J=1,4), WMED,
     2               (WLANE(2,J),J=1,4), WSHOLD(2),LANE(2),   MDIV(2),
     3               NSTRIP,    KDIV,      NLUA,      MEDIV,
     4               RECODE,    LUCODE,    C,         D,        EPSLN,
     5               DVBANG,    QQ
  850 FORMAT(2A1,I3,2I1,11F4.2,3I1,2I2,5I1,F4.2,3F2.0,F5.4)
C
      IF(TRACE(1))
     1   WRITE(6,9000) CARD,       UNIT,      PAVTYE,    MDIV(1),  LANE(1),
     2                 WSHOLD(1),(WLANE(1,J),J=1,4), WMED,
     3                 (WLANE(2,J),J=1,4), WSHOLD(2),LANE(2),   MDIV(2),
     4                 NSTRIP,    KDIV,      NLUA,      MEDIV,
     5                 RECODE,    LUCODE,    C,         D,        EPSLN,
     6                 DVBANG,    QQ
 9000 FORMAT(' C-CARD REPRINT -- ',2A1,I3,2I1,11F5.2,3I1,2I2,5I1,F5.2,
     *          3F3.0,F6.4)
C=================================================================
C=== INCLUDE THE FOLLOWING STATEMENT TO GET
C=== CORRECT NUMBER OF MEDIAN STRIPS
C     MEDIV = MEDIV*2
C=================================================================
C
C IF RECODE=2 TRAFFIC IS IN TWO DIRECTIONS
C -----------------------------------------
      RECODE = RECODE + 1
      IF(RECODE .EQ. 2) REV = .TRUE.
C
C IF UNITS=BLANK METRIC MEASUREMENTS
C -----------------------------------
      IF(UNIT .EQ. BLANK) UNIT = MM
C
C PAVEMENT NO.
C ------------
      IPAVE = PAVTYE - 300
C
```

```
C
      IF (D .EQ. 1) UPHILL = .TRUE.
      IF (EPSLN .LT. 0.0) WRITE(6,891)
      IF (ABS(EPSLN) .LT. 80) GOTO 90
      WRITE(6,892)
      ERROR = .TRUE.
   90 CONTINUE
C
  891 FORMAT(' ***WARNING*** ROAD ANGLE INPUTTED AS NEGATIVE QUANTITY'
     *       /T14,'HAS BEEN CONVERTED TO POSITIVE EQUIVALENT')
  892 FORMAT(' ***FATAL*** ROAD ANGLE INPUT TOO HIGH')
C
C CONVERSION OF DISABILITY VEILING BRIGHTNESS ANGLE FROM DEGREES TO
C RADIANS & IF ANGLE IS OMITTED TO ASSIGN DEFAULT VALUE OF 20 DEGREES
C--------------------------------------------------------------------
      QOO = QO
      ANGLIM = (DVBANG(1)+DVBANG(2)/60.+DVBANG(3)/3600.)*DETORA
      IF(ANGLIM .GT. 0.0) GO TO 100
      DVBANG(1) = 20.
      ANGLIM = 20.*DETORA
C
C
C CHECK FOR IMPERIAL UNITS
C ------------------------
  100 IF(UNIT .NE. FF) GO TO 120
      MF = 2
      HTDRIV = 5.
      PI10 = PI*10.
      FM90 = 300.
      QO = QO*PI
      GO TO 140
C
C ASSIGNMENT OF METRIC VALUES
C----------------------------
  120 MF = 1
      HTDRIV = 1.5
      PI10 = 10.
      FM90 = 90.
C
  140 IF(CARD .EQ. CC) GO TO 260
      WRITE(6,860) CC
      ERROR = .TRUE.
C
C INPUT CARD L LUMINAIRE DATA CARD
C --------------------------------
  260 READ(5,870)    CARD,        PATERN,  (NLR(K),TYPE(K),HT(K),
     1               OFFSET(K),LUSTAT(K),USTAT(K),K=1,4)
  870 FORMAT(A1,1X,I1,1X,4(I1,I3,F5.2,F4.1,I3,F3.1))
C
      IF(TRACE(1))   WRITE(6,9001) CARD,PATERN,(NLR(K),TYPE(K),HT(K),
     1               OFFSET(K),LUSTAT(K),USTAT(K),K=1,4)
 9001 FORMAT(' L-CARD REPRINT - ',A1,1X,I1,1X,4(I1,I3,F6.2,F5.1,I3,
     1       F4.1))
C
      IF(CARD .EQ. LL) GO TO 270
      WRITE(6,860) LL
      ERROR = .TRUE.
C
C INPUT F CARD FACTOR DATA CARD
C -----------------------------
  270 READ(5,875) CARD,(FMAIN(I),I=1,4),(PRORAT(I),I=1,4),DISTP
  875 FORMAT(A1,8F4.3,F5.2)
      IF(TRACE(1))
     *     WRITE(6,9002) CARD,(FMAIN(I),I=1,4),(PRORAT(I),I=1,4),DISTP
 9002 FORMAT(' F-CARD REPRINT -- ',A1,1X,8F5.3,F6.2)
      IF(CARD .EQ. FACT) GO TO 95
      WRITE(6,860) FACT
      ERROR = .TRUE.
   95 CONTINUE
C****
C****
C****
C
C ESTABLISHMENT OF PROPER FACTORS
C -------------------------------
      DO 99 I=1,4
      IF(FMAIN(I) .LE. 0.) FMAIN(I) = 1.
      IF(PRORAT(I) .LE. 0.) PRORAT(I) = 1.
      FFMAIN(I) = FMAIN(I)*PRORAT(I)
   99 CONTINUE
C
C   EDITING OF INPUT DATA
C   LIMITS OF EDITING:
C   1. DVB ANGLE NOT TO EXCEED 30 DEG. WITH DEFAULT TO 20 DEG.
C   2. MAXIMUM OF 90 STRIPS BETWEEN TWO CONSECUTIVE LUMINAIRS
C   3. NO. OF LANE WIDTH MUST CORRESPOND TO NO. OF LANES
C   4. NO. OF LUMINAIRES NOT TO EXCEED 12 LUMINAIRES PER CYCLE
C   5. NO OF STRIPS PER LANE TO BE 2 OR 4
C   6. NO OF STRIPS PER SHOULDER TO BE 4 OR LESS
C ------------------------------------------------------------
```

```
      IF((DVBANG(1).LE.30. .AND. DVBANG(2).LT.60. .AND. DVBANG(3).LT.60.
     1) .OR. (DVBANG(1).EQ.20. .AND. DVBANG(2).EQ.0. .AND. DVBANG(3).EQ.
     20.) .AND. NLUA.LE.12 .AND. KDIV.LE.90 .AND. MDIV(1).LE.4 .AND. MDI
     3V(2).LE.4 .AND. (NSTRIP.EQ.4 .OR. NSTRIP.EQ.2)) GO TO 110
C=================================================================
C=== CHANGE ABOVE STATEMENT TO THE FOLLOWING:
C    20.) .AND. NLUA.LE.12 .AND. KDIV.LE.90 .AND. MDIV(1).LE.2 .AND. MDI
C    3V(2).LE.2 .AND. (NSTRIP.EQ.2 .OR. NSTRIP.EQ.1)) GO TO 110
C=== TO GET REQUIRED NUMBER OF STRIPS.
C=================================================================
      WRITE(6,880) CC
      ERROR = .TRUE.
C
C... CHECK #3
C
  110 COUNTR = 0
      RDWD(1) = 0
      DO 111 J=1,4
      IF(WLANE(1,J).EQ.0) GO TO 111
      COUNTR = COUNTR + 1
      RDWD(1) = RDWD(1) + WLANE(1,J)
  111 CONTINUE
      IF(LANE(1).EQ.COUNTR) GO TO 113
      WRITE(6,880) CC
      ERROR = .TRUE.
  113 RDWAY(1) = RDWD(1)
      COUNTR = 0
      RDWD(2) = 0
      DO 114 J=1,4
      IF(WLANE(2,J).EQ.0) GO TO 114
      COUNTR = COUNTR + 1
      RDWD(2) = RDWD(2) + WLANE(2,J)
  114 CONTINUE
      IF(LANE(2).EQ.COUNTR) GO TO 280
      WRITE(6,880) CC
      ERROR = .TRUE.
  280 RDWAY(2) = RDWD(2)
C
C CHECK OF PATTERN WITH LUMINAIRE ROW VALUES
C ---------------------------------------------
      IF(TYPE(1).GT.0 .OR. TYPE(4).GT.0) PAT = 1
      IF(TYPE(1).GT.0 .AND. TYPE(4).GT.0) PAT = 2
      IF(TYPE(2).GT.0 .AND. TYPE(3).GT.0) PAT = 3
      IF(TYPE(1).GT.0 .AND. TYPE(2).GT.0 .AND. TYPE(3).GT.0) PAT = 5
      IF(TYPE(4).GT.0 .AND. TYPE(2).GT.0 .AND. TYPE(3).GT.0) PAT = 5
      IF(TYPE(1).GT.0 .AND. TYPE(2).GT.0 .AND. TYPE(3).GT.0 .AND.
     1    TYPE(4).GT.0) PAT = 4
      IF(PAT .NE. 0) GO TO 290
      WRITE(6,880) LL
      ERROR = .TRUE.
  290 IF(PATERN .EQ. PAT) GO TO 295
      PATERN = PAT
      WRITE(6,890)
C
C *** MIN. NO. OF INTERVALS OF LIGHT POLE DISTANCE IS 3 IN FRONT
C     AND REAR OF POINT UNDER EXAMINATION.
  295 IF(NLUA .GE. 3) GO TO 300
      NLUA = 3
      WRITE(6,895)
  895 FORMAT('***WARNING*** NO. OF LUMINAIRE INTERVALS IS CHANGED TO 3')
C
C...DISTANCE BETWEEN Y-COORDINATES IS NOT TO EXCEED 5 METRES (16.5 FT.)
C
      DELTAY = DISTP/KDIV
      IF (UNIT .EQ. FF .AND. DELTAY .GT. 16.5) WRITE(6,852) DELTAY
      IF (UNIT .NE. FF .AND. DELTAY .GT. 5.0) WRITE(6,851) DELTAY
  851 FORMAT(' ***WARNING*** IES REPORT STATES THAT DISTANCE BETWEEN',
     *      ' Y-COORDINATES SHOULD NOT EXCEED 5 METRES. DELTAY =',F8.2)
  852 FORMAT(' ***WARNING*** IES REPORT STATES THAT DISTANCE BETWEEN',
     *      ' Y-COORDINATES SHOULD NOT EXCEED 16.5 FEET. DELTAY =',F8.2)
C
C *** REPRINT INPUT DATA ***
C ------------------------
C
C
C ESTABLISHMENT OF CHAINAGE FOR EACH FIRST LUMINAIRE OF EACH ROW
C ---------------------------------------------------------------
  300 STGSWT = .FALSE.
      DO 148 I=1,4
  148 AUSTAT(I) = LUSTAT(I)*100 + USTAT(I)
      IF(AUSTAT(1).NE.AUSTAT(2) .OR. AUSTAT(1).NE.AUSTAT(4))
    1 STGSWT = .TRUE.
      DO 150 I=1,7
  150 PATLIN(I) = BLANK
      CONSID = BLANK
      SIDE = BLANK
```

```
C  SINGLE ROW OF LUMINAIRES
C ------------------------
      IF(PATERN .NE. 1) GO TO 155
      SNGL = SNGL1
      GO TO 180
C
C  TWO ROW OF LUMINAIRES
C ---------------------
  155 IF(PATERN .NE. 2) GO TO 160
      NO = TWOR
      MED = ARR1
      IF(STGSW1) MED = ARR2
      IF(STGSW1) PATLIN(5) = DU
      GO TO 180
C
C  SELECTION OF PROPE DESCRIPTION VALUES
C ---------------------------------------
  160 MED = MED1
      ARR = ARR1
      IF(STGSW1) ARR = ARR2
      IF(STGSW1) PATLIN(7) = DU
      GO TO (180,180,165,170,175,175) ,PATERN
  165 NO = TWOR
      GO TO 180
  170 NO = FOURR
      GO TO 180
  175 NO = THREER
      CONS1D = CONSD1
      OUTLIN(1) = LR(1)
      IF(PATERN .EQ. 6) OUTLIN(1) = LR(2)
C
C  WRITE & FORMAT STATEMENTS FOR REPRINTING OF INPUT DATA
C ------------------------------------------------------
  180 WRITE(6,900)
      IF(UNIT .EQ. FF) GO TO 301
      WRITE(6,901)
      GO TO 302
  301 WRITE(6,902)
C
C
  302 WRITE(6,903) TYPE, HT, OFFSET, (LUSTAT(K),USTAT(K),K=1,4)
      WRITE(6,904) PATLIN, OUTLIN
      IF(EPSLN .EQ. 0) WRITE(6,905) DISTP
      IF(EPSLN .NE. 0) WRITE(6,906) DISTP,DISTPR
      WRITE(6,907) LANE, NDIV(1), ROWAY(1), FM(MF), WMED,
     1 ROWAY(2), FM(MF), NDIV(2), FM(MF)
C
  860 FORMAT(' ***FATAL*** WRONG CARD SEQUENCE-CARD ',A1)
  880 FORMAT(' ***FATAL***WRONG INPUT DATA IN CARD ',A1)
  890 FORMAT(' PATTERN NO. RE-ASSIGNED ACCORDING TO LUMINAIRES GIVEN ' )
  900 FORMAT(/T6,'REPRINT INPUT DATA'/T6,'------- ----- ----' )
  901 FORMAT(/T6,'UNIT = METER ')
  902 FORMAT(/T6,'UNIT = FOOT ')
  903 FORMAT(/T6,'LUMINAIRE   ROW NUMBER',T51,'1',T71,'2',T91,'3'
     1  ,T111,'4'/T18,'TYPE',T32,4(17X,I3)/
     2  T18,'MOUNTING HEIGHT',T35,4(15X,F5.2)/
     3  T18,'OVER HANG FROM CURB',T49,F6.2,3(14X,F6.2)/
     4  T18,'FIRST LUM. POSITION',T46,4(I3,'+',F5.2,11X)// )
  904 FORMAT(T6,'PATTERN :',7A4,T44,8('-'),T71,21('-'),T111,8('-')/
     1  T17,5A4,T44,'|',T51,'O',T71,'O',T81,'|',T91,'O',T111,'O',
     2  T118,'|',2(/T44,'|',T81,'|',T118,'|'))
  905 FORMAT(T6,'DIST. BET''N LUM. POLE =',F7.2,T44,'|',T81,'|',
     1  T118,'|',2(/T44,'|',T81,'|',T118,'|'))
  906 FORMAT(T6,'DIST. BET''N LUM. POLE',T44,'|',T81,'|',T118,'|'/
     1  T10,'=',F9.2,' HORIZONTALLY',T44,'|',T81,'|',T118,'|'/T10,
     2  '=',F9.2,' ALONG ROAD SURFACE',T44,'|',T81,'|',T118,'|')
  907 FORMAT(3(T44,'|',T81,'|',T118,'|'/),T39,9('-'),T58,
     1  I2,' LANE.' ,T78,7('-'),T96,I2,' LANE.',T115,9('-')/
     2  T39,I2,' LANE |-----------',F5.2,A3,'-------------|',F5.2,
     3  '|-----------',F5.2,A3,'-----------|',I2,' LANE'/
     4  T41,'STRIPS',T80,A3,T118,'STRIPS')
C==================================================================
C=== INCLUDE FOLLOWING STATEMENTS TO GET REQUIRED
C=== NUMBER OF STRIPS:
C     NDIV(1) = NDIV(1)*2
C     NDIV(2) = NDIV(2)*2
C==================================================================
      IB1 = DVBANG(1)
      IB2 = DVBANG(2)
      IB3 = DVBANG(3)
      WRITE(6,908) PAVTYP, PAVE(IPAVE), Q00
  908 FORMAT(//T6,'PAVEMENT TYPE',T44,'= ',I6,1X,A4,
     1 /T6,'LUMINANCE CO-EFFICIENT QO',T44,'= ',F9.4)
```

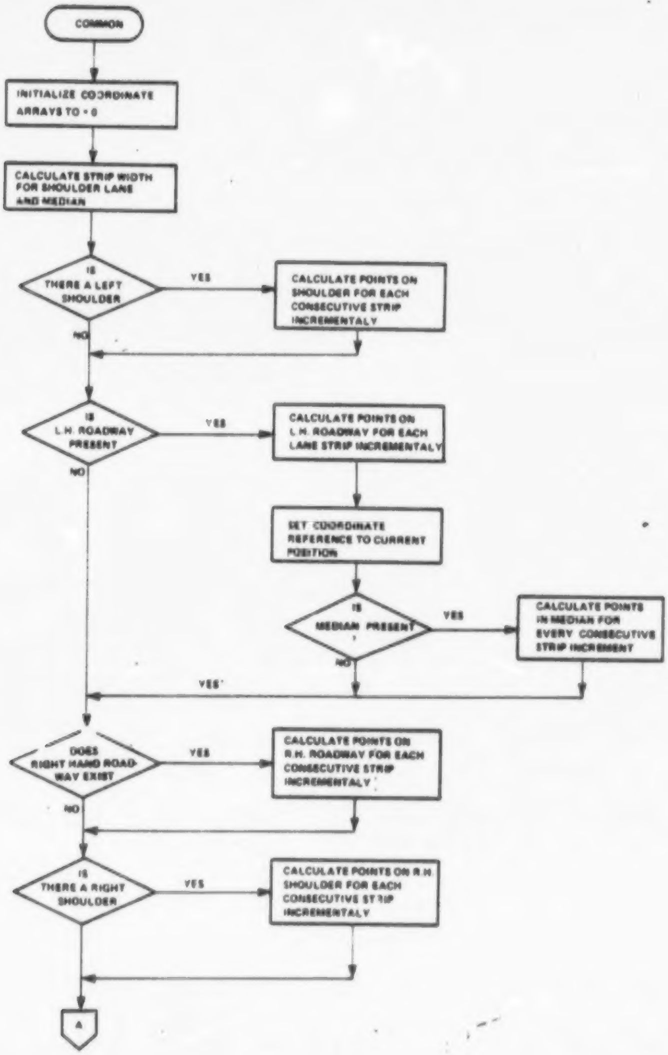
```
C
      KOUNT = 1
      WRITE(6,501)
      DO 500 I=1,4
      IF(PATERN.EQ.1 .AND. I.GT.1) GO TO 500
      IF(PATERN.EQ.2 .AND. I.GT.1 .AND. I.LT.4) GO TO 500
      IF(PATERN.EQ.3 .AND. (I.LT.2 .OR. I.GT.3)) GO TO 500
      IF(PATERN.EQ.5 .AND. I.GT.3) GO TO 500
      IF(PATERN.EQ.6 .AND. I.LT.2) GO TO 500
      IF(KOUNT .EQ. 1) GO TO 510
      IF(ABS(PRORAT(I)-1.000) .LE. 0.00001) GO TO 511
      WRITE(6,505) I, FMAIN(I), PRORAT(I), FFMAIN(I)
      GO TO 500
  511 WRITE(6,503) I, FMAIN(I)
      GO TO 500
  510 KOUNT = 2
      IF(ABS(PRORAT(I)-1.000) .LE. 0.00001) GO TO 512
      WRITE(6,504) I, FMAIN(I), PRORAT(I), FFMAIN(I)
      GO TO 500
  512 WRITE(6,502) I, FMAIN(I)
  500 CONTINUE
  501 FORMAT(/,T6,'MAINTENANCE FACTORS')
  502 FORMAT('+',T30,'ROW NUMBER ',I1,'  = ',F9.4)
  503 FORMAT(T30,'ROW NUMBER ',I1,'  = ',F9.4)
  504 FORMAT('+',T30,'ROW NUMBER ',I1,'  = ',F9.4,
     1 ' X PRORATING FACTOR OF ',F5.2,' = ',F8.4)
  505 FORMAT(T30,'ROW NUMBER ',I1,'  = ',F9.4,
     1 ' X PRORATING FACTOR OF ',F5.2,' = ',F8.4)
C
      WRITE(6,1000) NLUA,KDIV,IH1,IH2,IH3,EPSLN,TRAFDI(RECODE),NSTRIP
 1000 FORMAT(/T6,'LUMINAIRE INTERVALS IN FRONT/REAR OF          ',
     1       /T6,'STUDY AREA FOR CALCULATION              = ',I4,
     2       /T6,'NO. OF STRIPS BETWEEN TWO LUM. POLES    = ',I4,
     3       /T6,'DVM ANGLE LIMIT                         = ',I4,
     4        ' DEG.',I3,' MIN.',I3,' SEC.',
     5       /T6,'SLOPE OF ROAD                           = ',F7.2,
     6        ' DEG',
     7       /T6,A3,' WAY TRAFFIC (TRAFFIC ON RIGHT ROADWAY INTO ',
     8        'DIAGRAM; TRAFFIC ON LEFT ROADWAY OUT OF DIAGRAM)',
     9       /T6,I1,' STRIPS PER LANE')
C=============================================================
C=== INPUT FIX-UP TO ALLOW USER TO SPECIFY NSTRIP=2
C=== TO GET 2 STRIPS/LANE INSTEAD OF NSTRIP=4.
C
C     NSTRIP = NSTRIP*2
C=============================================================
C
C
      IF(SILMP) WRITE(6,910)
  910 FORMAT(T6,'ONE LUMINAIRE PER ROW FOR CALCULATION.')
C
      EPSLN = EPSLN*PI/180.
      DO 98 I=1,4
      FMAIN(I) = FFMAIN(I)
   98 CONTINUE
      DO 303 I=1,50
  303 NSEQ(I) = 0
C
  320 WRITE(6,325)
  325 FORMAT(///,1X,'LUMINAIRE DESCRIPTION',//,
     1 1X,'LAMP CODE',3X,'MANUFACTURER',4X,'REFERENCE NO',5X,
     2 'DESCRIPTION',14X,'I.E.S. TYPE',6X,'INIT. LUMENS',
     3 3X,'LIFE SPAN')
      II = 0
      DO 410 I=1,4
      IRINDX(I) = 0
  410 ITEMP(I) = TYPE(I)
C
      DO 420 I=1,4
      IF(ITEMP(I) .EQ. 0) GO TO 420
      II = II + 1
      NREC(II) = ITEMP(I)
      JL = I + 1
      DO 415 J=JL,4
      IF(ITEMP(J) .EQ. 0) GO TO 415
      IF(ITEMP(J) .EQ. ITEMP(I)) ITEMP(J) = 0
  415 CONTINUE
  420 CONTINUE
C
```

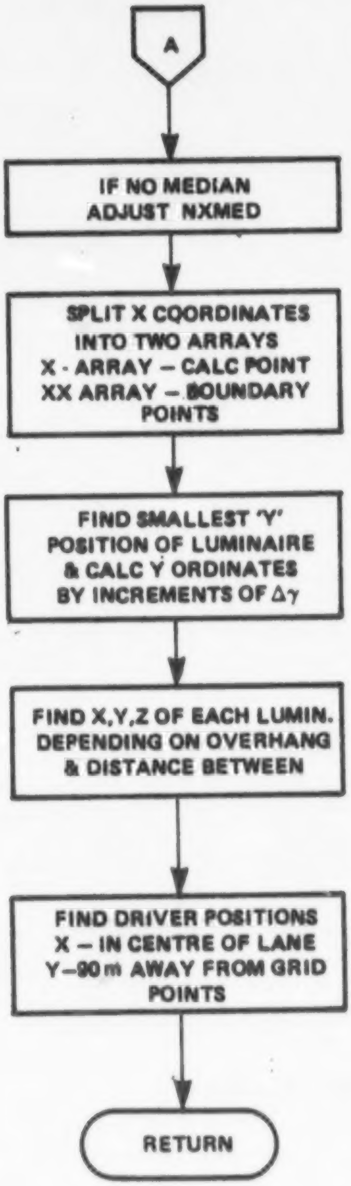
```
C
      DO 450 I=1,11
      I1=1
      DO 430 J=1,300
      READ(8'I1) (IA(L),L=1,18), ITBL, LUMENS, LIFESP
      IF(ITBL .EQ. NREC(I)) GO TO 435
  430 CONTINUE
  435 WRITE(6,360) (IA(L),L=1,18), LUMENS, LIFESP
  360 FORMAT(3X,A4,7X,17A4,8X,I6,8X,I6)
C
C SELECTION OF INDEX TABLE TO CORRESPOND WITH LUMINAIRE TYPE
C ------------------------------------------------------------
      IX = I1 - 1
      DO 440 L=1,4
      IF(TYPE(L) .EQ. ITBL) IRINDX(L) = IX
  440 CONTINUE
  450 CONTINUE
C
      IF(.NOT.ERROR) GO TO 9999
      RETURN 1
 9999 RETURN
      END
```

D.3/ COORD and COORD1 Routines Flowcharts and Programs Listing

Both of these routines use the input data to define a rectangular co-ordinate grid pattern within the study area based on the numbers of divisions between consecutive luminaires and strips on shoulders, lanes and medians. Each of these routines generates a slightly different grid pattern -- for details, see Section 2.3 on Program Options. In order that illuminance and luminance values can be calculated for each of the grid points, the relative position of the luminaires and driver or observer must be known. For this reason these routines define the position of each luminaire and the position of the driver for each lane (in centre) in the direction of travel 90 m in front of each grid point.

COORD1.


COMMON
INITIALIZE COORDINATE ARRAYS TO = 0
CALCULATE STRIP WIDTH FOR SHOULDER LANE AND MEDIAN
IS THERE A LEFT SHOULDER
YES
CALCULATE POINTS ON SHOULDER FOR EACH CONSECUTIVE STRIP INCREMENTALY
NO
IS L.H. ROADWAY PRESENT
YES
CALCULATE POINTS ON L.H. ROADWAY FOR EACH LANE STRIP INCREMENTALY
NO
SET COORDINATE REFERENCE TO CURRENT POSITION
IS MEDIAN PRESENT ?
YES
CALCULATE POINTS IN MEDIAN FOR EVERY CONSECUTIVE STRIP INCREMENT
NO
YES
DOES RIGHT HAND ROAD-WAY EXIST
YES
CALCULATE POINTS ON R.H. ROADWAY FOR EACH CONSECUTIVE STRIP INCREMENTALY
NO
IS THERE A RIGHT SHOULDER
YES
CALCULATE POINTS ON R.H. SHOULDER FOR EACH CONSECUTIVE STRIP INCREMENTALY
A

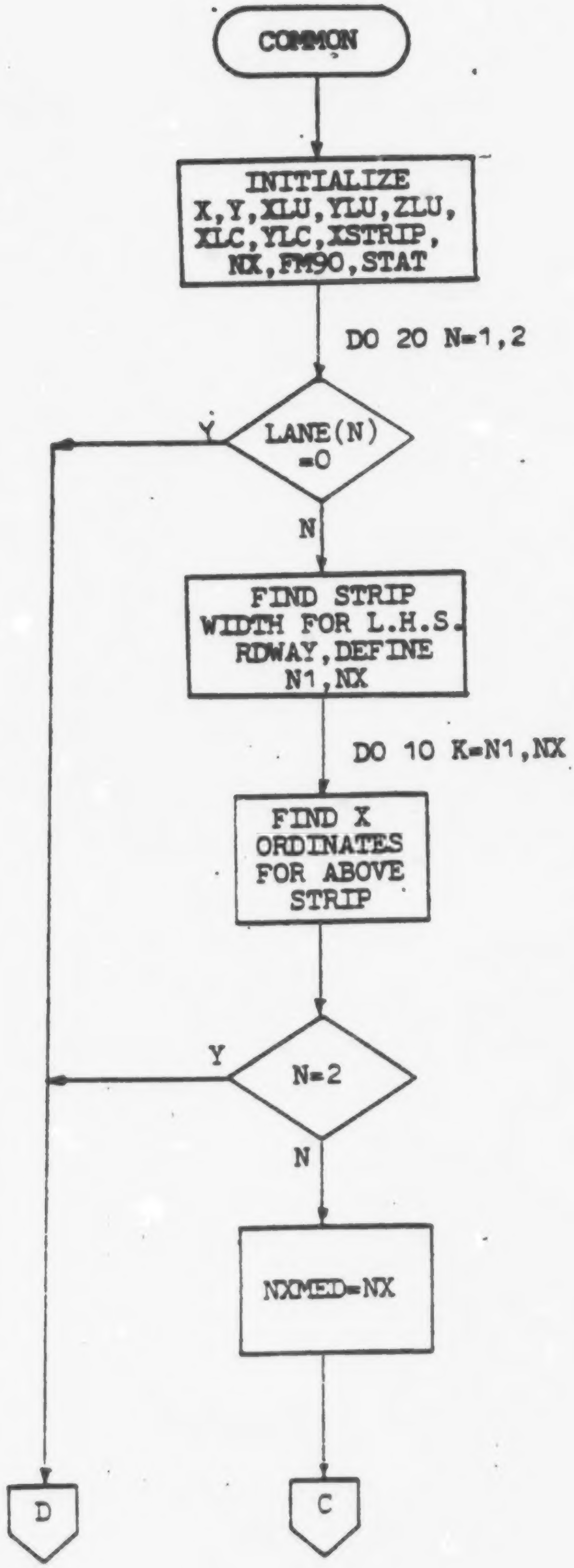

A
IF NO MEDIAN ADJUST NXMED
SPLIT X COORDINATES INTO TWO ARRAYS X - ARRAY – CALC POINT XX ARRAY – BOUNDARY POINTS
FIND SMALLEST 'Y' POSITION OF LUMINAIRE & CALC Y ORDINATES BY INCREMENTS OF Δγ
FIND X,Y,Z OF EACH LUMIN. DEPENDING ON OVERHANG & DISTANCE BETWEEN
FIND DRIVER POSITIONS X – IN CENTRE OF LANE Y–90 m AWAY FROM GRID POINTS
RETURN

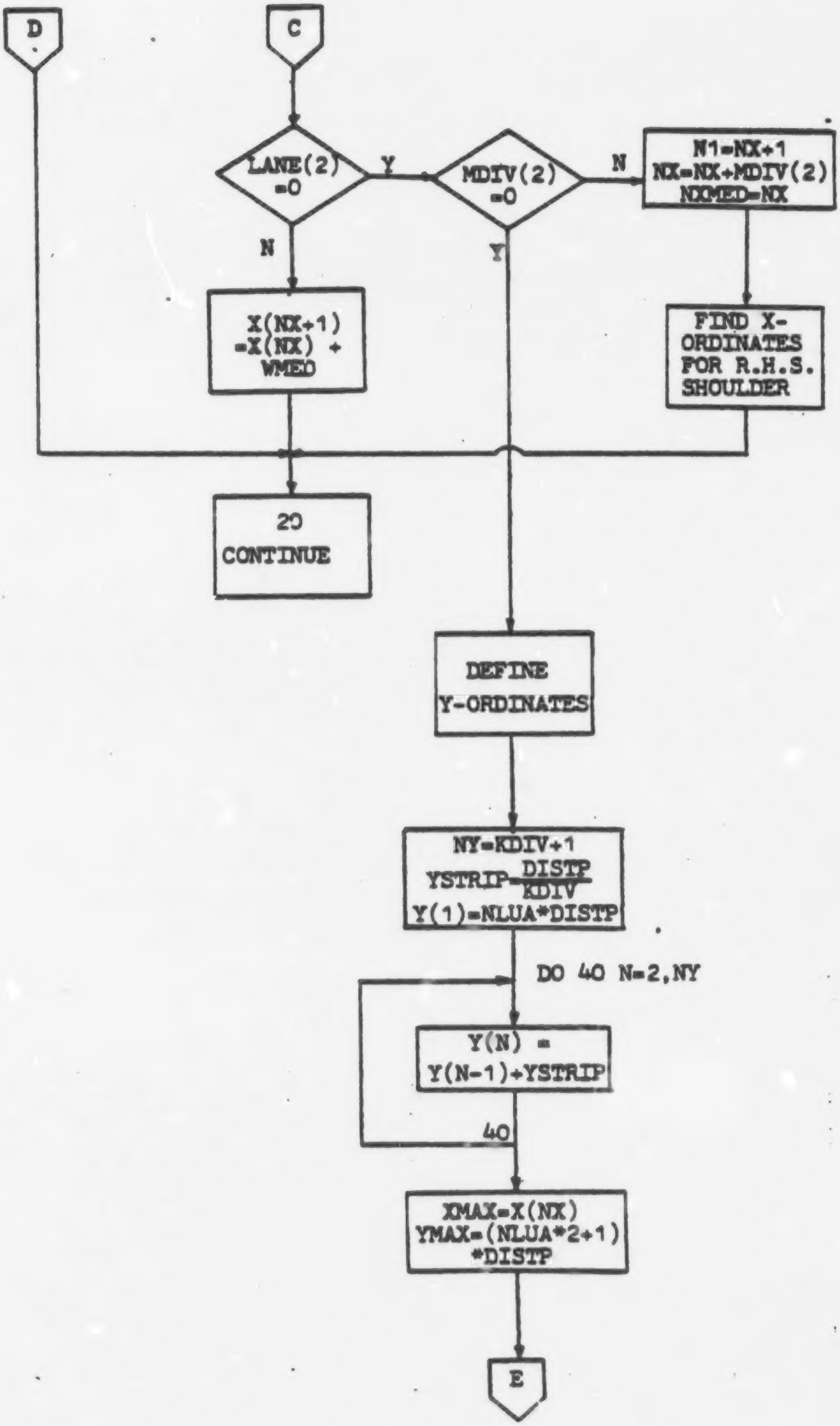
```
      SUBROUTINE COORD1
C
C  THIS ROUTINE DEFINES THE FOLLOWING:
C  1. A COORDINATE SYSTEM AS SPECIFIED BY INPUT REQUIREMENTS WITH ORIGIN
C     AT THE BOTTOM OF THE LEFT HAND SIDE OF THE STUDY AREA.
C  2. DEFINES THE COORDINATES OF EACH LUMINAIRE
C  3. DEFINES THE COORDINATES OF DRIVER POSITION IN THE DRIVING DIRECTION
C     ******************************************************************
C     ******************************************************************
C
      COMMON /ONE/  DISTP,     DVBANG(3),FMAIN(4), HT(4),     KDIV,
     1              LANE(2),   LUSTAT(4),MDIV(2),  NLR(4),    NLUA,
     2              NSTRIP,    OFFSET(4),PATERN,   PAVTYE,    QO,
     3              RDWAY(2),  REV,      TYPE(4),  UNIT,      USTAT(4),
     4              WMED,      LUCODE,   MANUF,    RADIUS,    ICURVE,
     5              C,         IRINOX(4),EPSLN,    UPHILL,    WLANE(2,4),
     6              WSHOLD(2),MEDIV,     RDWD(2)
C
      COMMON /TWO/  STAT(4),  X(46),  XLC(91,8),  XLU(26,4),XSTRIP(2),
     1              PAVE(4),  Y(91),  YLC(91,8),  YLU(26,4),ZLU(26,4),
     2              NC,       NLU(4), NX,         NXMED,     NY,
     3              DELTAX(91,46),    DELTAY(91,46),
     4              XSSTRP(2),XMSTRP, NLX,   NMX, XX(25)
C
      COMMON /CONST/DETORA, PI, HAFPI, PI10, HTORIV, FM90, ANGLIM,
     1              TYPNO, NMANU, NOPN, SILMP, TRACE
C
      COMMON /FIVE/ FMNEW,AMDA
C
      LOGICAL         ERROR, REV, SILMP
      LOGICAL*1       TRACE(3)
      INTEGER*4       TYPE, PATERN, PA1, PAVTYE
      REAL            NEWARC
      REAL*8          THAYTA, THEYTA, YSTRIP
C
C
      IF(TRACE(1)) WRITE(6,9000)
 9000 FORMAT(/' SUBROUTINE COORD1 ENTERED'/)
C
C DETERMINE STARTING CHAINAGE OF EACH LUMINAIRE ROW
C ------------------------------------------------
C
      STAT(1) = FLOAT(LUSTAT(1))*100. + USTAT(1)
      STAT(2) = FLOAT(LUSTAT(2))*100. + USTAT(2)
      STAT(3) = FLOAT(LUSTAT(3))*100. + USTAT(3)
      STAT(4) = FLOAT(LUSTAT(4))*100. + USTAT(4)
C
      IF(TRACE(1)) WRITE(6,9001) STAT
 9001 FORMAT(' STARTING CHAINAGES --- 1   -- 2   -- 3   --    4'
     *       /20X,4F10.0)
C
C INITIALIZATION OF X Y COORDINATES
C ---------------------------------
      DO 9 I=1,43
    9 X(I) = 0.
C
      DO 11 I=1,100
   11 Y(I) = 0.
C
C INITIALIZATION OF LUMINAIRE COORDINATES
C ---------------------------------------
      DO 7 J=1,4
      DO 7 I=1,26
      XLU(I,J) = 0.
      YLU(I,J) = 0.
    7 ZLU(I,J) = 0.
C
C INITIALIZATION OF DRIVER POSITION
C ---------------------------------
      DO 8 I=1,10
      DO 8 J=1,100
      XLC(J,I) = 0.
    8 YLC(J,I) = 0.
C
      DO 16 I3=1,43
      DELTAX(1,I3) = 0.
      DELTAY(1,I3) = 0.
   16 CONTINUE
C
C...TO GENERATE X-COORDINATES OF GRID SYSTEM BASED ON FOLLOWING:
C      1. EACH SHOULDER HAS 4 STRIPS OF SPECIFIED WIDTH
C      2. EACH LANE HAS 4 STRIPS OF SPECIFIED WIDTH
C      3. THE MEDIAN HAS 4 STRIPS OF SPECIFIED WIDTH
C
```

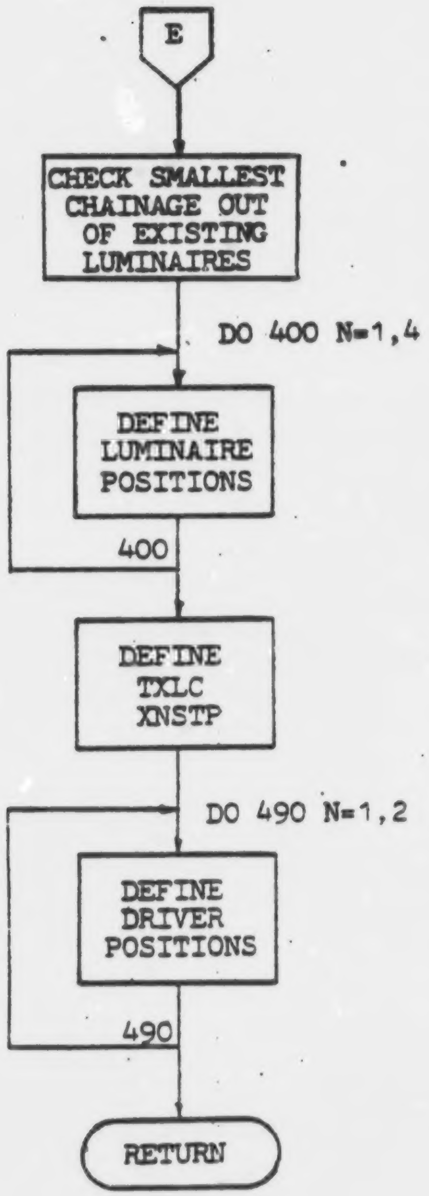
```
C
C WIDTH OF EACH STRIP (I.E.SHOULDER,LANE,MEDIAN)
C ---------------------------------------------
      DO 580 I=1,2
      IF(MDIV(I) .EQ. 0) GO TO 581
      XSSTRP(I) =WSHOLD(I)/FLOAT(MDIV(I))
  581 IF(LANE(I) .EQ. 0) GO TO 580
      XSTRIP(I) = RDWD(I)/FLOAT(LANE(I)*NSTRIP)
  580 CONTINUE
      IF(MEDIV .EQ. 0) GO TO 582
      XMSTRP = WMED/FLOAT(MEDIV)
  582 CONTINUE
C
      IF(TRACE(1)) WRITE(6,9002) XSSTRP,XSTRIP,XMSTRP
 9002 FORMAT(' XSSTRP(1)=',F6.3,' XSSTRP(2)=',F6.3,' XSTRIP(1)=',F6.3,
     *       ' XSTRIP(2)=',F6.3,' XMSTRP=',F6.3)
C
C GENERATION OF X-ORDINATES
C -------------------------
      NX = 1
C
C LEFT SHOULDER
C -------------
      IF(MDIV(1) .EQ. 0) GO TO 210
      N1 = NX + 1
      NX = NX + MDIV(1)
      DO 200 K=N1,NX
  200 X(K) = X(K-1) + XSSTRP(1)
C
  210 CONTINUE
C
C LEFT ROADWAY
C ------------
      IF(LANE(1) .EQ. 0) NXMED = NX
      IF(LANE(1) .EQ. 0) GO TO 250
      N1 = NX + 1
      NX = NX + LANE(1)*NSTRIP
      DO 230 K=N1,NX
  230 X(K) = X(K-1) + XSTRIP(1)
  235 NXMED = NX
C
C MEDIAN
C ------
      IF(MEDIV .EQ. 0) GOTO 250
      N1 = NX + 1
      NX = NX + MEDIV
      DO 240 K=N1,NX
  240 X(K) = X(K-1) + XMSTRP
C
  250 CONTINUE
C
C RIGHT ROADWAY
C -------------
      IF(LANE(2) .EQ. 0) GOTO 270
      N1 = NX + 1
      NX = NX + LANE(2)*NSTRIP
      DO 260 K=N1,NX
  260 X(K) = X(K-1) + XSTRIP(2)
C
  270 CONTINUE
C
C RIGHT SHOULDER
C --------------
      IF(MDIV(2).EQ.0) GO TO 285
      N1 = NX + 1
      NX = NX + MDIV(2)
      DO 260 K=N1,NX
  280 X(K) = X(K-1) + XSSTRP(2)
C
C CHOOSE ONLY REQUIRED QUARTER POINTS (X - ARRAY)
C ( XX - ARRAY CONTAINS THE REMAINING POINTS FOR FUTURE AVE. CALC.)
C ------------------------------------------------------------------
  285 NXMEL = (NXMED + 1)/2
      DO 286 II=1,NXMED
      XX(II) = X(2*II-1)
      X(II)  = X(2*II)
  286 CONTINUE
C
C..IF THERE ARE NO STRIPS IN THE MEDIAN THEN XX-ARRAY CONTAINS TWO
C  CONSECUTIVE POINTS AT EITHER EDGES OF THE MEDIAN
C
      IF(MEDIV .NE. 0 .OR. WMED .EQ. 0.) GOTO 288
C
      XX(NXMEL + 1) = X(NXMED)
      NX = NX/2 - 1
      DO 287 II=NXMED,NX
      XX(II) = X(2*II+1)
      X(II)  = X(2*II+2)
  287 CONTINUE
```

```
C
      NXMED = NXMED - 1
      GOTO 290
C
  288 IF(LANE(2).NE.0 .OR. MDIV(2).NE.0) GOTO 1288
      NXMED = NXMED - 1
      GOTO 290
 1288 NNX = NX
      NX = (NX-1)/2
      NXX = NX + 1
      XX(NXX) = X(NNX)
      I1 = NXMED + 1
      DO 289 II=I1,NX
      XX(II) = X(2*II-1)
      X(II) = X(2*II)
  289 CONTINUE
      IF(WMED.EQ.0.) NXMED = NXMED - 1
C
C REPRINT X-ARRAY
C ---------------
  290 IF(TRACE(1)) WRITE(6,9006) ((I,X(I)),I=1,NX)
 9006 FORMAT(/' X-ORDINATES '/(' X(',I3,' ) =',F7.2))
C
C
C     Y-ORDINATES (GRID POINTS)
C     -------------------------
      NY = KDIV + 1
      YSTRIP = DISTP/FLOAT(KDIV)
C
      Y(1) = NLUA*YSTRIP*FLOAT(KDIV)
      DO 40 N=2,NY
      Y(N) = Y(N-1) + YSTRIP
      IF(TRACE(1)) WRITE(6,611)N,Y(N)
  611 FORMAT('0',T2,'Y(',I2,') =',F8.3)
   40 CONTINUE
C
      XMAX = X(NX)
      YMAX = FLOAT(NLUA*2+1)*DISTP
C.....................................................................
      IF(SIEMP) YMAX = 0.
C.....................................................................
C
C...LUMINAIRE CO-ORDINATES
C...FIND MININUM STATION FOR CORRESPONDING LUMINAIRE PATTERN
C
      GO TO (1,2,3,4,5,6), PATERN
    1 STATO = STAT(1)
      IF(TYPE(4) .NE. 0) STATO = STAT(4)
      GO TO 300
    2 STATO = MIN1(STAT(1),STAT(4))
      GO TO 300
    3 STATO = MIN1(STAT(2),STAT(3))
      GO TO 300
    4 STATO = MIN1(STAT(1),STAT(2),STAT(3),STAT(4))
      GO TO 300
    5 STATO = MIN1(STAT(1),STAT(2),STAT(3))
      GO TO 300
    6 STATO = MIN1(STAT(2),STAT(3),STAT(4))
C
C  ASSIGN NEW NAMES TO OLD VARIABLES FOR PROGRAMMING CONVENIENCE
C  PAVE(1) = X -ORDINATE FOR LEFT EDGE OF ROADWAY
C  ------------------------------------------------------------
C
  300 PAVE(1) = FLOAT(MDIV(1))*XSSTRP(1)
      PAVE(2) = RDWAY(1)
      PAVE(3) = WMED
      PAVE(4) = RDWAY(2)
      NPOLES = NLUA*2 + 2
      OFFSET(2) = -OFFSET(2)
      OFFSET(4) = -OFFSET(4)
  301 EDGE = 0
C
C  ESTABLISHMENT OF X , Y , Z COORDINATES FOR EACH LUMINAIRE
C  ---------------------------------------------------------
      DO 400 N=1,4
      NL = 1
      EDGE = EDGE + PAVE(N)
      TXLU = EDGE + OFFSET(N)
      IF(TYPE(N) .EQ. 0) GO TO 400
      XLU(1,N) = TXLU
      YLU(1,N) = STAT(N) - STATO
      ZLU(1,N) = HT(N)
  360 NL = NL + 1
  110 YLU(NL,N) = YLU(NL-1,N) + DISTP
      XLU(NL,N) = TXLU
      ZLU(NL,N) = HT(N)
      IF(YLU(NL,N) .LT. YMAX) GO TO 360
      IF(YLU(NL,N) .GT. YMAX) NL = NL - 1
  120 NLU(N) = NL
  400 CONTINUE
```

```
C
C
C     DRIVER'S POSITION- LANE CENTER LINE -CO-ORDINATES
      NC = 1
      TXLC = FLOAT(MD(Y(1)))*XSTRIP(1)
      XNSTP = FLOAT(NSTRIP)/2.
      DO 490 N=1,2
      TXLC = TXLC + XSTRIP(N)*XNSTP
C
      XSTP4 = XSTRIP(N)*FLOAT(NSTRIP)
      NC1 = NC - 1 + LANE(N)
      DO 430 L=NC,NC1
      DO 430 LY=1,NY
CXXXXXXXXXXXXXXXXXXXXXXXXXX DRIVER X-POSITIONS XXXXXXXXXXXXXXXXXXXXXXX
C
  650 XLC(LY,L) = TXLC + XSTP4*(L-NC)
C
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
C
C  ---
C
CYYYYYYYYYYYYYYYYYYYYYYYYYYYYY DRIVER Y-POSITIONS YYYYYYYYYYYYYYYYYYYYYYY
C
C...THE FIRST DRIVER POSITION ON EACH CENTER LINE IS 90 METERS FROM THE
C    FIRST POINT OF OBSERVATION ON THE CENTER LINE.
C
      IF(N.EQ.1 .AND. .NOT.REV) GO TO 470
      YLC(LY,L) = Y(1) - FM90 + YSTRIP*(LY-1)
C
C
C                                      FIRST CASE
C
C                                      SECOND CASE
      GO TO 430
  470 YLC(LY,L) = Y(NY) + FM90 - YSTRIP*(LY-1)
C
CYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
C
  430 CONTINUE
C
  485 IF(N .EQ. 2) GO TO 490
      IF(LANE(2) .EQ. 0) GO TO 500
      TXLC = PAVE(1) + PAVE(2) + PAVE(3)
      NC = NC1 + 1
  490 CONTINUE
  500 NC = NC1
      RETURN
      END
```


COMMON
INITIALIZE X,Y,XLU,YLU,ZLU, XLC,YLC,XSTRIP, NX,FM90,STAT
DO 20 N=1,2
LANE(N) =0
Y
N
FIND STRIP WIDTH FOR L.H.S. RDWAY,DEFINE N1,NX
DO 10 K=N1,NX
FIND X ORDINATES FOR ABOVE STRIP
N=2
Y
N
NXMED=NX
D
C


D
C
LANE(2) =0
Y
N
MDIV(2) =0
N
Y
N1=NX+1
NX=NX+MDIV(2)
NXMED=NX
X(NX+1) =X(NX) + WMED
FIND X-ORDINATES FOR R.H.S. SHOULDER
20 CONTINUE
DEFINE Y-ORDINATES
NY=KDIV+1
YSTRIP=DISTP/KDIV
Y(1)=NLUA*DISTP
DO 40 N=2,NY
Y(N) = Y(N-1)+YSTRIP
40
XMAX=X(NX)
YMAX=(NLUA*2+1) *DISTP
E


E
CHECK SMALLEST CHAINAGE OUT OF EXISTING LUMINAIRES
DO 400 N=1,4
DEFINE LUMINAIRE POSITIONS
400
DEFINE TXLC XNSTP
DO 490 N=1,2
DEFINE DRIVER POSITIONS
490
RETURN

```
      SUBROUTINE COORD
C
C *** THIS ROUTINE USES INPUT DATA TO DEFINE CO-ORDINATES OF LUMINAIRES
C     AND GRID POINT LOCATIONS. ORIGIN OF THIS SYSTEM IS ON THE LEFT
C     HAND SIDE OF THE DESIGNER (WHEN LOOKING AHEAD OF CHAINAGE) AT THE
C     INTERSECTION OF LINE CROSSING THE FIRST LUMINAIRE AND THE LEFTMOST
C     LINE FORMING THE GRID SYSTEM.
C
C     ***************************************************************************
C
      COMMON /ONE/   DISTP,     DVRANG(5),FMAIN(4), HT(4),     KDIV,
     1               LANE(2),   LUSTAT(4),MDIV(2),  NLR(4),    NLUA,
     2               NSTRIP,    OFFSET(4),PATERN,   PAVTYE,    QQ,
     3               RDWAY(2), REV,       TYPE(4),  UNIT,      USTAT(4),
     4               WMED,      LUCODE,   MANUF,    RADIUS,    ICURVE,
     5               C,         IRINDX(4),[illegible]SLN,    UPHILL,    WLANE(2,4),
     6               WSHOLD(2),MEDIV,     [illegible]WD(2)
C
      COMMON /TWO/   STAT(4),   X(46),    XLC(91,8),  XLU(26,4),XSTRIP(2),
     1               PAVE(4),   Y(91),    YLC(91,8),  YLU(26,4),ZLU(26,4),
     2               NC,        NLU(4), NX,           NXMED,     NY,
     3               DELTAX(91,46),       DELTAY(91,46),
     4               XSSTRP(2),XMSTRP, NLX,           NMX
C
      COMMON /CONST/DETORA, PI, HAFPI, PI10, HTDRIV, FM90, ANGLIM,
     1              TYPNO, NMANU, NOPN, SILMP, TRACE
C
      COMMON /FIVE/ FMNEW,AMDA
C
      LOGICAL        ERROR, REV, SILMP
      LOGICAL*1      TRACE(3)
      INTEGER*4      TYPE, PATERN, PAT, PAVTYE
      REAL           NEWARC
      REAL*8         THAYTA, THEYTA, YSTRIP
C
C...FIND BOUNDARY OF STUDY AREA
C
      STAT(1) = FLOAT(LUSTAT(1))*100. + USTAT(1)
      STAT(2) = FLOAT(LUSTAT(2))*100. + USTAT(2)
      STAT(3) = FLOAT(LUSTAT(3))*100. + USTAT(3)
      STAT(4) = FLOAT(LUSTAT(4))*100. + USTAT(4)
C
C...INITIALIZATION
C
      DO 9 I=1,46
    9 X(I) = 0.
C
      DO 11 I=1,100
   11 Y(I) = 0.
C
      DO 7 J=1,4
      DO 7 I=1,26
      XLU(I,J) = 0.
      YLU(I,J) = 0.
    7 ZLU(I,J) = 0.
C
      DO 8 I=1,10
      DO 8 J=1,100
      XLC(J,I) = 0.
    8 YLC(J,I) = 0.
C
      DO 580 I=1,2
      IF(LANE(I) .EQ. 0) GO TO 580
      XSTRIP(I) = RDWAY(I)/(FLOAT(LANE(I)*NSTRIP))
  580 CONTINUE
C
C..WHEN THE ROAD CURVES A CHECK HAS TO BE MADE TO INSURE THAT THE DRIVER
C   CAN SEE THE REQUIRED DISTANCE AROUND THE CURVE
C
      IF(ICURVE .EQ. 0) GO TO 13
C
C*********************CURVE BLOCK*******************************************
C
      FMNEW = RADIUS*ARCOS(1.-FM90**2./(2.*RADIUS**2.))
C
      IF(ICURVE .EQ. -1) NEWARC = RADIUS*ARCOS(1.-(RDWAY(1)/LANE(1)/2.
     1 +FLOAT(MDIV(1))*XSTRIP(1))/(RADIUS-RDWAY(1)+RDWAY(1)/LANE(1)/2.))
C
      IF(ICURVE .EQ. 1) NEWARC = RADIUS*ARCOS(1.-(RDWAY(2)/LANE(2)/2.+
     1 FLOAT(MDIV(2))*XSTRIP(2))/(RADIUS-RDWAY(2)+RDWAY(2)/LANE(2)/2.))
C
      IF(FMNEW .GT. NEWARC*2.) FMNEW = NEWARC
      IF(RDWAY(2) .NE. 0) FMNEW = FMNEW*(RADIUS+ICURVE*(RDWAY(1)/2.
     1 +WMED/2.))/RADIUS
      AMDA = FMNEW/RADIUS
C
C*********************CURVE BLOCK*******************************************
C
   13 CONTINUE
```

```
C...LOOP FOR EACH ROW OF LUMINAIRE
C
      DO 400 N=1,4
      NL = 1
      EDGE = EDGE + PAVE(N)
      TXLU = EDGE + OFFSET(N)
      IF(TYPE(N) .EQ. 0) GO TO 400
      XLU(1,N) = TXLU
      YLU(1,N) = STAT(N) - STATO
      ZLU(1,N) = HT(N)
C
      IF(ICURVE .NE. 0) YLU(1,N) = (RADIUS-ICURVE*
     1 (TXLU-PAVE(2)/2.-PAVE(1)))*SIN((STAT(N)-STATO)
     2 /(RADIUS-ICURVE*(TXLU-PAVE(2)/2.-PAVE(1))))
C======>IF ROAD IS CURVED, CORRECTION IS NEEDED FOR YLU
C
      IF(ICURVE .NE. 0) XLU(1,N) = YLU(1,N)*TAN((STAT(N)-
     1 STATO)/(RADIUS-ICURVE*(TXLU-PAVE(2)/2.-PAVE(1)/2.)))
     2 *ICURVE + TXLU
C=====>IF ROAD IS CURVED, CORRECTION IS NEEDED FOR XLU
C
  360 NL = NL + 1
      IF(ICURVE .EQ. 0) GO TO 110
C
C                 ****************************************
C                 *                                      *
C     *********** LUMINAIRE LOCATION BLOCK FOR CURVES    ***********
C     *           *                                      *          *
C     *           ****************************************          *
C
C     *                                                             *
            Q = XLU(1,N) - ROWAY(1)/2. - FLOAT(MDIV(1))
C     *      *XSTRIP(1)
C     *                                                             *
            THEYTA = DISTP/RADIUS
C     *                                                             *
            DELTXL = (RADIUS-ICURVE*Q)*(1.-DCOS(THEYTA*
C     *      (NL-1)))*ICURVE
C                                                                   *
            DELTYL = (RADIUS-ICURVE*Q)*DSIN(THEYTA*(NL-1))
C     *                                                             *
            XLU(NL,N) = TXLU + DELTXL
C     *                                                             *
            YLU(NL,N) = DELTYL
C     *                                                             *
            ZLU(NL,N) = HT(N)
C     *                                                             *
      IF(TRACE(1)) WRITE(6,609) NL,N,XLU(NL,N),NL,N,YLU(NL,N),Q,DELTXL,
     1                   DELTYL,RADIUS,THEYTA
  609 FORMAT('0',' XLU(',I2,',',I2,') = ',F10.2/T2,'YLU(',
     1 I2,',',I2,') = ',F10.2/T2,'Q = ',F10.2/T2,'DELTXL = ',
     2 F10.2/T2,'DELTYL = ',F10.2/T2,'RADIUS =',F10.2/T2,
     3 'THEYTA =',F10.6)
            IF(NL .LT. NPOLES) GO TO 360
C     *                                                             *
            GO TO 120
C     *                                                             *
C     ***************************************************************
C
C
  110 YLU(NL,N) = YLU(NL-1,N) + DISTP
      XLU(NL,N) = TXLU
      ZLU(NL,N) = HT(N)
      IF(YLU(NL,N) .LT. YMAX) GO TO 360
      IF(YLU(NL,N) .GT. YMAX) NL = NL - 1
  120 NLU(N) = NL
  400 CONTINUE
C
      IF(TRACE(1))
     *     WRITE(6,9003) (((I,XLU(I,J),YLU(I,J),ZLU(I,J)),J=1,4),I=1,NL)
 9003 FORMAT(/'    I        XLU(I,1-4)',22X,'YLU(I,1-4)',12X,'ZLU(I,1-4)'
     *     //1X,I4,2X,12F8.2)
C
C
C...DRIVER'S POSITION- LANE CENTER LINE -CO-ORDINATES
C
      NC = 1
      TXLC = FLOAT(MDIV(1))*XSTRIP(1)
      XNSTP = FLOAT(NSTRIP)/2.
      DO 490 N=1,2
      TXLC = TXLC + XSTRIP(N)*XNSTP
C
      IF(ICURVE .NE. 0) R2 = RADIUS - ICURVE*(TXLC -
     1  PAVE(1) - PAVE(2)/2.)
C=====>CURVE STATEMENT
```

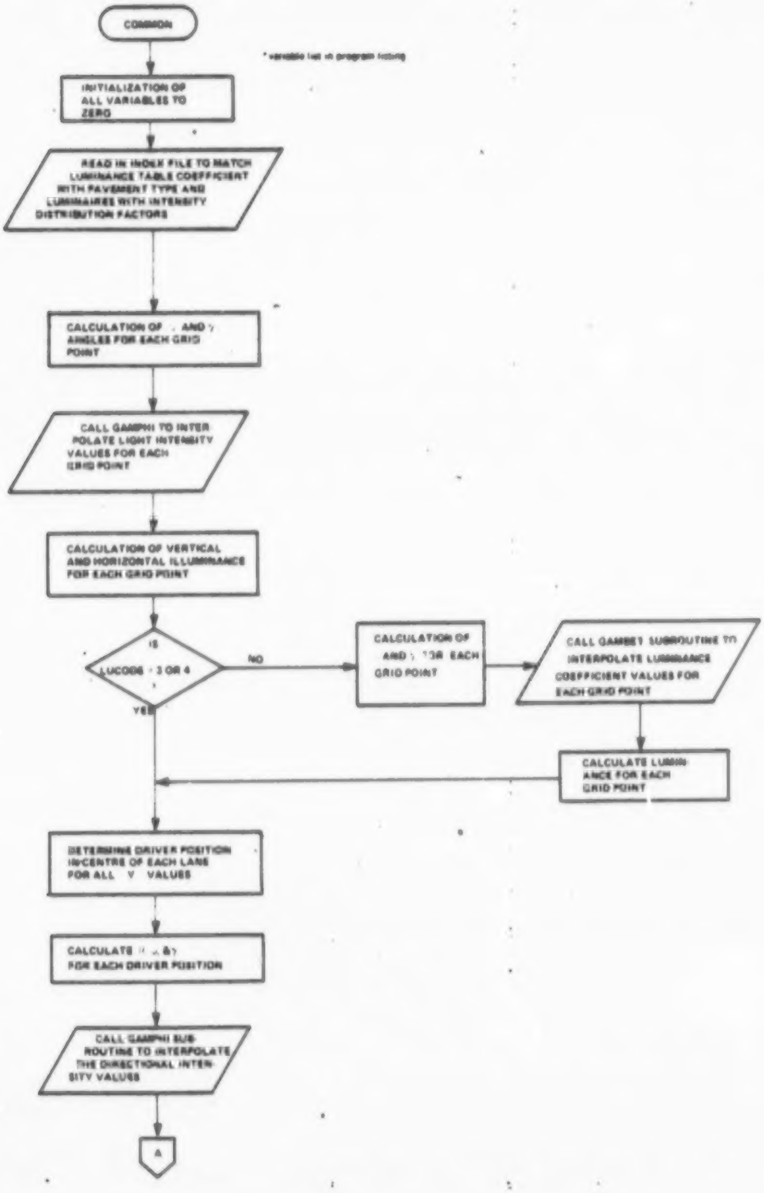
```
   19 IF(MDIV(2) .EQ. 0) GO TO 30
      N1 = NX + 1
      NX = NX + MDIV(2)
      NXMED = NX
      DO 18 K=N1,NX
   18 X(K) = X(K-1) + XSTRIP(1)
      IF(ICURVE .EQ. 0) GO TO 20
C
C*********CURVED GRID**********CURVED GRID*********CURVED GRID*********
C
      DO 605 K=N1,NX
        Q = ICURVE*(RDWAY(1)/2 + (K-1)*XSTRIP(1))
        DO 605 I5=2,NY
          DELTAX(I5,K) = (RADIUS-Q)*(1.-DCOS(THAYTA*(I5-1)+NLUA
     1    *DISTP/RADIUS))*ICURVE
          DELTAY(I5,K) = (RADIUS-Q)*DSIN(THAYTA*(I5-1)
     1    +NLUA*DISTP/RADIUS)
  605 CONTINUE
C
C*********CURVED GRID*********CURVED GRID*********CURVED GRID*********
C
   20 CONTINUE
C
   30 IF(TRACE(1)) WRITE(6,9000) ((I,X(I)),I=1,NX)
 9000 FORMAT(/' X-ORDINATES '/('X(',I3,' ) =',F8.2))
C
C
C...Y-ORDINATES (GRID POINTS)
C
      NY = KDIV + 1
      YSTRIP = DISTP/FLOAT(KDIV)
C
      IF(RDWAY(2).NE.0 .AND. ICURVE.NE.0) YSTRIP = YSTRIP*
     1 (RADIUS-ICURVE*(RDWAY(1)/2.+WMED/2.))/RADIUS
C=====>CURVE STATEMENT
C
      Y(1) = NLUA*YSTRIP*FLOAT(KDIV)
      DO 40 N=2,NY
      Y(N) = Y(N-1) + YSTRIP
      IF(TRACE(1)) WRITE(6,611)N,Y(N)
  611 FORMAT('0',I2,'Y(',I2,') =',F8.3)
   40 CONTINUE
C
      IF(RDWAY(2).NE.0 .AND. ICURVE.NE.0) YSTRIP = YSTRIP*
     1 RADIUS/(RADIUS-ICURVE*(RDWAY(1)/2.+WMED/2.))
C=====>CURVE STATEMENT
C
      XMAX = X(NX)
      YMAX = FLOAT(NLUA*2+1)*DISTP
C.....................................................................
      IF(SILMP) YMAX = 0.
C.....................................................................
C
C...LUMINAIRE CO-ORDINATES
C...FIND MINIMUM STATION FOR CORRESPONDING LUMINAIRE PATTERN
C
      GO TO (1,2,3,4,5,6), PATERN
    1 STATO = STAT(1)
      IF(TYPE(4) .NE. 0) STATO = STAT(4)
      GO TO 300
    2 STATO = MIN1(STAT(1),STAT(4))
      GO TO 300
    3 STATO = MIN1(STAT(2),STAT(3))
      GO TO 300
    4 STATO = MIN1(STAT(1),STAT(2),STAT(3),STAT(4))
      GO TO 300
    5 STATO = MIN1(STAT(1),STAT(2),STAT(3))
      GO TO 300
    6 STATO = MIN1(STAT(2),STAT(3),STAT(4))
C
C...ASSIGN NEW NAMES TO OLD VARIABLES FOR PROGRAMMING CONVENIENCE
C     PAVE(1) = X -ORDINATE FOR LEFT EDGE OF ROADWAY
C
  300 PAVE(1) = FLOAT(MDIV(1))*XSTRIP(1)
  350 PAVE(2) = RDWAY(1)
      PAVE(3) = WMED
      PAVE(4) = RDWAY(2)
      NPOLES = NLUA*2 + 2
      OFFSET(2) = -OFFSET(2)
      OFFSET(4) = -OFFSET(4)
  301 EDGE = 0
C
```

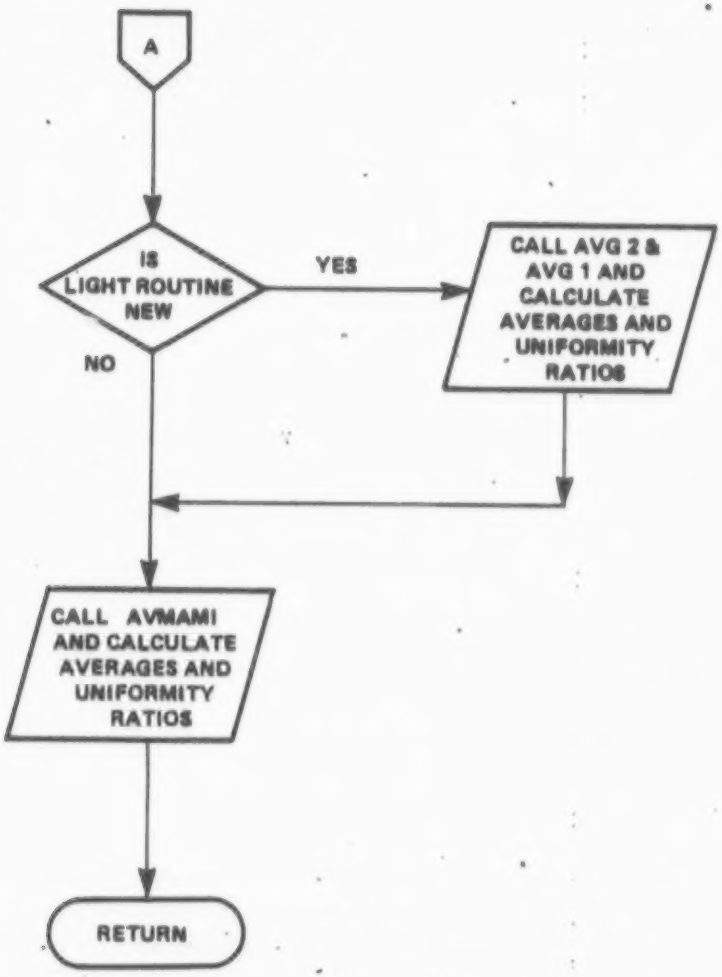
```
      DO 600 I3=1,46
      DELTAX(1,I3) = 0.
      DELTAY(1,I3) = 0.
  600 CONTINUE
      NX = 0
      NY = KDIV + 1
C
C...X-ORDINATES, ASSUMPTION: EACH LANE HAS 2 OR 4 STRIPS (GRID POINTS)
C
      DO 20 N=1,2
      IF(LANE(N) .EQ. 0) GO TO 20
      N1 = NX + 2
      N2 = N1 - 1
      NX = MDIV(N) + LANE(N)*NSTRIP + 1 + NX
C
      IF(ICURVE .EQ. 0) GO TO 100
C=====>ICURVE IS 0 FOR A STRAIGHT ROAD
C
C
C                  ************************************
C                  *                                  *
C   ****************   BLOCK FOR CURVED ROAD GRID      ***************
C   *              *                                  *              *
C   *              ************************************              *
C   *                                                                *
                IF((RDWAY(2).NE.0) .AND. (N.EQ.1))                   *
    *            RADIUS = RADIUS + ICURVE*(RDWAY(1)/2.
    *            + WMED/2.)
C
C   *     =====>IF THERE IS A SECOND ROADWAY, CONVERT RADIUS TO      *
C               THAT OF THE CENTER LINE OF LHS ROADWAY
C   *
                IF((RDWAY(2).NE.0) .AND. (N.EQ.1))                   *
    *            DISTP = DISTP*RADIUS/(RADIUS-ICURVE*
    *            (WMED/2.+RDWAY(1)/2.))
C
C   *     =====>WHEN DISTP IS GIVEN ALONG CENTER LINE OF MEDIAN,     *
C               CONVERT TO CENTER LINE OF LHS ROADWAY
C   *                                                                *
                YSTRIP = DISTP/FLOAT(KDIV)
C   *                                                                *
                THAYTA = YSTRIP/RADIUS
C   *                                                                *
                DO 601 I1=N2,NX
C   *                                                                *
                Q = X(I1) - RDWAY(1)/2. - FLOAT(MDIV(1))
    *            *XSTRIP(1)
                DO 602 I2=1,NY
C   *                                                                *
                DELTAX(I2,I1) = (RADIUS-ICURVE*Q)*(1.-
    *            DCOS(THAYTA*(I2-1)+NLOA*DISTP/RADIUS))
    *            *ICURVE
C   *                                                                *
                DELTAY(I2,I1) = (RADIUS-ICURVE*Q)*
    *            DSIN(THAYTA*(I2-1)+NLOA*DISTP/RADIUS)
      IF(TRACE(1))  WRITE(6,607)I2,I1,DELTAX(I2,I1),I2,I1,
     1       DELTAY(I2,I1),I1,X(I1),I2,Y(I2),YSTRIP,THAYTA,RADIUS,Q
  607 FORMAT('0',T2,'DELTAX(',I2,',',I2,') =',F8.2/T12,'DELTAY(',
     1 I2,',',I2,') =',F8.2/T11,'X(',I2,') =',F8.2/T11,'Y(',I2,
     2 ') =',F8.2/T10,'YSTRIP =',F8.3/T10,'THAYTA =',F8.4/
     3 T11,'RADIUS =',F8.2/T15,'Q = ',F8.2)
C   *
  602           CONTINUE                                             *
C   *                                                                *
                X(I1+1) = X(I1) + XSTRIP(N)
C   *                                                                *
  601           CONTINUE                                             *
C   *                                                                *
                GO TO 111
C   *                                                                *
C   ******************************************************************
C
C
C...DEFINE X-ORDINATES (GRID POINT)
C
  100 CONTINUE
      DO 10 K=N1,NX
   10 X(K) = X(K-1) + XSTRIP(N)
  111 IF(N .EQ. 2) GO TO 20
C
C...NXMED IS THE POINT ON THE FAR RIGHT OF THE L.H.S. ROADWAY
C
      NXMED = NX
      IF(LANE(2) .EQ. 0) GO TO 19
C
      X(NX+1) = X(NX) + WMED
      GO TO 20
```

```
C
      XSTP4 = XSTRIP(N)*FLOAT(NSTRIP)
      IF(ICURVE .NE. 0) WRITE(6,608) N,FMNEW,NEWARC,R1,TXLC,XSTP4,REV,
     1 DISTP,NLUA
  608 FORMAT('0',T2,'-------N = ',I1,'-------'/T2,'FMNEW =',F10.4/T2,
     1 'NEWARC =',F10.4/T2,'R1 =',F8.2/T2,'TXLC =',F8.2/T2,'XSTP4 =',
     2 F8.2/T2,'REV = ',G4/T2,'DISTP =',F9.4/T2,'NLUA =',I2)
C
      NC1 = NC - 1 + LANE(N)
C
      DO 430 L=NC,NC1
      DO 430 LY=1,NY
C
      IF(ICURVE .EQ. 0) GO TO 650
C
C                   ***************************************
C                   *                                     *
C     ***************   CURVE DRIVER POSITION BLOCK       ****************
C     *             *                                     *              *
C     *             ***************************************              *
C     *                                                                  *
C     *                                                                  *
C                   IF(ROWAY(N) .EQ. 0) GO TO 485
C     *                                                                  *
                    R1 = R2 - ICURVE*(XSTP4*(L-NC))
C     *                                                                  *
                    IF((N .EQ. 1) .AND. (.NOT. REV)) GO TO 670
C     *         =====> BRANCH FOR SECOND CASE                            *
C     *                                                                  *
                    XLC(LY,L) = ICURVE*R1*(1.-DCOS((NLUA*
     *               DISTP-FMNEW+(LY-1)*YSTRIP)/RADIUS)) +
     *               (TXLC+(L-NC)*XSTP4)
C     *                                                                  *
                    YLC(LY,L) = R1*DSIN((NLUA*DISTP-FMNEW
     *               +(LY-1)*YSTRIP)/RADIUS)
C     *                                                                  *
                    GO TO 430
C     *                                                                  *
C     *                        FIRST CASE                                *
C     *------------------------------------------------------------------*
C     *                        SECOND CASE                               *
C     *                                                                  *
  670               XLC(LY,L) = (TXLC+(L-1)*XSTP4) + R1*
     *               ICURVE*(1.-DCOS((FMNEW+NLUA*DISTP+
     *               (LY-1)*YSTRIP)/RADIUS))
C     *                                                                  *
                    YLC(LY,L) = R1*DSIN((FMNEW+NLUA*DISTP+
     *               (LY-1)*YSTRIP)/RADIUS)
C     *                                                                  *
                    GO TO 430
C     *                                                                  *
C     ********************************************************************
C
C
C
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CXXXXXXXXXXXXXXXXXXXXXXXXXXX DRIVER X-POSITIONS XXXXXXXXXXXXXXXXXXXXXXXXX
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
C
C
  650 XLC(LY,L) = TXLC + XSTP4*(L-NC)
C
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
C
C
CYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
CYYYYYYYYYYYYYYYYYYYYYYYYYYY DRIVER Y-POSITIONS YYYYYYYYYYYYYYYYYYYYYYYYY
CYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
C
C
C...THE FIRST DRIVER POSITION ON EACH CENTER LINE IS 90 METERS FROM THE
C    FIRST POINT OF OBSERVATION ON THE CENTER LINE.
C
      IF(N.EQ.1 .AND. .NOT.REV) GO TO 470
      YLC(LY,L) = Y(1) - FM90 + YSTRIP*(LY-1)
C
C                                  FIRST CASE
C----------------------------------------------------------------------
C                                  SECOND CASE
C
      GO TO 425
  470 YLC(LY,L) = Y(NY) + FM90 - YSTRIP*(LY-1)
C
CYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
CYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
CYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYYY
C
  425 IF(TRACE(1)) WRITE(6,606) LY,L,XLC(LY,L),LY,L,YLC(LY,L),R1
  606 FORMAT('C',I2,'XLC(',I2,',',I2,') =',F9.4/T2,'YLC(',I2,',',I2
     1 ,') =',F9.4/T2,'R1 =',F9.2)
  430 CONTINUE
C
  485 IF(N .EQ. 2) GO TO 490
      IF(LANE(2) .EQ. 0) GO TO 500
      TXLC = PAVE(1) + PAVE(2) + PAVE(3)
      NC = NC1 + 1
  490 CONTINUE
  500 NC = NC1
      IF(ICURVE .NE. 0) FM90 = FMNEW
      RETURN
      END
```

D.4/ LIGHT Subroutine Flowchart and Program Listing

This subroutine calculates the angular relationship between each luminaire and each grid point and driver position. Based on this relationship, illuminance, luminance and disability veiling brightness are calculated.


COMMON
* variable list in program listing
INITIALIZATION OF ALL VARIABLES TO ZERO
READ IN INDEX FILE TO MATCH LUMINANCE TABLE COEFFICIENT WITH PAVEMENT TYPE AND LUMINAIRES WITH INTENSITY DISTRIBUTION FACTORS
CALCULATION OF AND ANGLES FOR EACH GRID POINT
CALL GAMPHI TO INTERPOLATE LIGHT INTENSITY VALUES FOR EACH GRID POINT
CALCULATION OF VERTICAL AND HORIZONTAL ILLUMINANCE FOR EACH GRID POINT
IS LUCODE 3 OR 4
NO
YES
CALCULATION OF AND FOR EACH GRID POINT
CALL GAMBET SUBROUTINE TO INTERPOLATE LUMINANCE COEFFICIENT VALUES FOR EACH GRID POINT
CALCULATE LUMINANCE FOR EACH GRID POINT
DETERMINE DRIVER POSITION IN CENTRE OF EACH LANE FOR ALL Y VALUES
CALCULATE &
FOR EACH DRIVER POSITION
CALL GAMPHI SUBROUTINE TO INTERPOLATE THE DIRECTIONAL INTENSITY VALUES
A


A
IS LIGHT ROUTINE NEW
YES
NO
CALL AVG 2 & AVG 1 AND CALCULATE AVERAGES AND UNIFORMITY RATIOS
CALL AVMAMI AND CALCULATE AVERAGES AND UNIFORMITY RATIOS
RETURN

```
      SUBROUTINE LIGHT(NEW)
C
C  ***THIS ROUTINE CALLS ROUTINES 'GAMPHI', AND 'BETGAM', AND
C .   CALCULATES LIGHT INTENSITY DISTRIBUTION, REFLECTANCE AND
C     DISABILITY VEILING BRIGHTNESS.
C
C     ***************************************************************
C
      COMMON /ONE/  DISTP,       DVMANG(3),FMAIN(4), HT(4),      KDIV,
     1              LANE(2),     LUSTAT(4),MDIV(2),  NLK(4),     NLUA,
     2              NSTRIP,      OFFSET(4),PATERN,   PAVTYE,     WO,
     3              NOWAY(2),    REV,      TYPE(4),  UNIT,       USTAT(4),
     4              WMED,        LUCODE,   MANUF,    RADIUS,     ICURVE,
     5              C,           IKINDX(4),EPSLN,    UPHILL,     WLANE(2,4),
     6              WSHOLD(2),MEDIV,       KDWU(2)
C
      COMMON /TWO/  STAT(4),   X(46),    XLC(91,8),  XLU(26,4),XSTRIP(2),
     1              PAVE(4),   Y(91),    YLC(91,8),  YLU(26,4),ZLU(26,4),
     2              NC,        NLU(4),   NX,         NXMED,    NY,
     3              DELTAX(91,46),       DELTAY(91,46),
     4              XSSTRP(2),XMSTRP,    NLX,        NMX
C
C
      COMMON /THREE/BETA(20), DIST(37,29), DVM(91,8),  EP(91,46),
     1        GAMA(29),       REF(91,46),    REFLEC(20,49),  EVAVG(10),
     2        EVMAX(10),      EVMIN(10),     EVAVMI(10),     EVMAAV(10),
     3        EVMAMI(10),     REFAVG(10),    REFMAX(10),     REFMIN(10),
     4        REAVMI(10),     REMAAV(10),    REMAMI(10),     NEP(91,46),
     5        EPV(91,46),     EPVAVG(10),    EPVMAX(10),     EPVMIN(10),
     6        EPVAMN(10),     EPVMXA(10),    EPVMXM(10),     NEPV(91,46),
     7        EVAVGS(2),      EVMAXS(2),     EVMINS(2),      EVAVMS(2),
     8        EVMAVS(2),      EVMAMS(2),     EVAVGM,         EVMAXM,
     9        EVMINM,         EVAVMM,        EVMAVM,         EVMAMM,
     *        PVAVGS(2),      PVMAXS(2),     PVMINS(2),      PVAVMS(2),
     1        PVMAVS(2),      PVMAMS(2),     PVAVGM,         PVMAXM,
     2        PVMINM,         PVAVMM,        PVMAVM,         PVMAMM
C
C
      COMMON /CONST/DETORA, PI, HAFPI, PI10, HTURIV, FM90, ANGLIM,
     1              TYPNU, NMANU, NOPN, SILMP, TRACE
C
      LOGICAL         SILMP
      LOGICAL*1       TRACE(3)
C
      COMMON /FOUR/ RAVG(10),RMAX(10),RMIN(10),
     1              RMAAV(10),RAVMI(10),RMAMI(10)
      COMMON /FIVE/ FMNEW, AMUA
      DIMENSION  IAA(25)
C
      INTEGER*4  TYPE, PATERN, PAT, PAVTYE, TYPER4
      REAL*4     DIST1(26,4)
      REAL       MU, KAPPA
      LOGICAL    ERROR, REV, UPHILL,NEW
C
      REWIND 9
      REWIND 10
C
C INITIALIZATION
C --------------
      DO 120 M=1,NX
      DO 120 K=1,NY
      EP(K,M) = 0.
      EPV(K,M) = 0.0
  120 REF(K,M) = 0.
      DO 130 M=1,NC
      DO 130 K=1,NY
  130 DVM(K,M) = 0.
C
      DO 135 M=1,10
      EVAVG(M) = 0.
      EVMAX(M) = 0.
      EVMIN(M) = 0.
      EVAVMI(M) = 0.
      EVMAAV(M) = 0.
      EVMAMI(M) = 0.
      REFAVG(M) = 0.
      REFMAX(M) = 0.
      REFMIN(M) = 0.
      REAVMI(M) = 0.
      REMAAV(M) = 0.
      REMAMI(M) = 0.
  135 CONTINUE
```

```
C
      DO 136 M=1,2
      EVAVGS(M) = 0.
      EVMAXS(M) = 0.
      EVMINS(M) = 0.
      EVAVMS(M) = 0.
      EVMAVS(M) = 0.
      EVMAMS(M) = 0.
      PVAVGS(M) = 0.
      PVMAXS(M) = 0.
      PVMINS(M) = 0.
      PVAVMS(M) = 0.
      PVMAVS(M) = 0.
      PVMAMS(M) = 0.
  136 CONTINUE
C
      EVAVGM = 0.
      EVMAXM = 0.
      EVMINM = 0.
      EVAVMM = 0.
      EVMAVM = 0.
      EVMAMM = 0.
      PVAVGM = 0.
      PVMAXM = 0.
      PVMINM = 0.
      PVAVMM = 0.
      PVMAVM = 0.
      PVMAMM = 0.
C
      IF(TRACE(2)) WRITE(6,9000) NX,NY,NC,TYPE,IRINDX,XLU,YLU,ZLU,NLU
 9000 FORMAT('1  SUBROUTINE LIGHT ENTERED'/3X,24('=')//
     1  '  INITIALIZATION OF ARRAYS  --  NX =',I4,' NY =',I5,' NC =',
     2  I5/'  TYPE(1 - 4) ==> ',4I5,7X,'IRINDX(1 -4) ==>',4I5/
     3  ' XLU, 1:',4X,13F9.2/7X,13F9.2/
     4  '       2:',4X,13F9.2/7X,13F9.2/
     5  '       3:',4X,13F9.2/7X,13F9.2/
     6  '       4:',4X,13F9.2/7X,13F9.2//
     7  ' YLU, 1:',4X,13F9.2/7X,13F9.2/
     8  '       2:',4X,13F9.2/7X,13F9.2/
     9  '       3:',4X,13F9.2/7X,13F9.2/
     *  '       4:',4X,13F9.2/7X,13F9.2//
     1  ' ZLU, 1:',4X,13F9.2/7X,13F9.2/
     2  '       2:',4X,13F9.2/7X,13F9.2/'      3:',4X,13F9.2/7X,13F9.2/
     3  '       4:',4X,13F9.2/7X,13F9.2//' NLU(1-4) ==> ',4I8)
C
C
      II = 301
      DO 137 I=1,50
      READ(8'II) (IAA(L),L=1,18), ITBL, LUMENS
      II = II + 1
      IF(ITBL .NE. PAVTYE) GO TO 137
      IP = II - 301
      GO TO 138
  137 CONTINUE
  138 READ(12'IP) (BETA(M),(REFLEC(M,N),N=1,29),M=1,20)
C
      ALUMEN = LUMENS/100.
      DO 400 ICC=1,20
      DO 400 IBB=1,29
  400 REFLEC(ICC,IBB) = REFLEC(ICC,IBB)/ALUMEN
      IF(TRACE(2)) WRITE(6,9001) (BETA(M),(REFLEC(M,N),N=1,29),M=1,20)
 9001 FORMAT(//' BETA            REFLEC(1-29)'/(1X,
     1          F8.4,6X,10F9.4/17X,10F9.4/17X,9F9.4))
C
C...DETERMINE LIGHT INTENSITY FOR POINTS ACROSS ROADWAY IN BETWEEN TWO
C    LAMP POLES
C
C...DO LOOP BASED ON GRID POINT Y-ORDINATES
C
      DO 140 K2=1,NY
      YP = Y(K2)
C
C...DO LOOP BASED ON GRID POINT X-ORDINATES
C
      DO 141 K1=1,NX
      XP = X(K1)
C
      IF(ICURVE .NE. 0) XP = X(K1) + DELTAX(K2,K1)
C=====>IF ROAD IS CURVED, ADD DELTAX TO OBTAIN POINT FOR A CURVE
C
      IF(ICURVE .NE. 0) YP = DELTAY(K2,K1)
C=====>IF ROAD IS CURVED, USE DELTAY INSTEAD OF Y
C
      IF(TRACE(2)) WRITE(6,9002) K1,K2,XP,YP
 9002 FORMAT(/' K1 =',I5,'  K2 =',I5,'  XP =',F8.2,'  YP =',F8.2)
C
```

```
      DO 144 K3=1,4
      DO 144 K33=1,26
  144 DIST1(K33,K3) = 0.
C
C...DEFINE ANGLE PHI, GAMA FOR A POINT
C
C...DO LOOP BASED ON NO. OF ROWS OF LUMINAIRES.
C
      DO 142 K4=1,4
      IF(TYPE(K4) .EQ. 0) GO TO 142
      NN = NLU(K4)
      TYPEK4 = IRIMUX(K4)
      IF(K4 .EQ. 1) GO TO 1422
      IF(IRIMUX(K4-1) .EQ. IRIMUX(K4)) GO TO 1423
 1422 READ(11'TYPEK4) (GAMA(N),(DIST(M,N),M=1,37),N=1,29)
      IF (IMAGE(2) .AND. K1.EQ.1 .AND. K2.EQ.1)
     *     WRITE(6,9003) (GAMA(N),(DIST(M,N),M=1,37),N=1,29)
 9003 FORMAT(//' GAMA          DIST(1-29)'/(1X,
     1         F8.4,8X,10F9.1/2(17X,10F9.1/),17X,7F9.1))
C
C...DO LOOP BASED ON MAX NO. OF LUMINAIRES ON EACH ROW OF LUMINAIRES.
C
 1423 CONTINUE
      DO 143 K5=1,NN
      XL = XLU(K5,K4)
      YL = YLU(K5,K4)
      ZL = ZLU(K5,K4)
      IF(ZL .LT. 0.) GO TO 143
      A = XL - XP
      B = YL - YP
      IF(A .EQ. 0.) GO TO 151
      PHI = ATAN(ABS(B/A))
  151 IF(A .EQ. 0.) PHI = HAFPI
      IF(A.EQ.0. .AND. B.EQ.0.) PHI = 0.
      IF(TRACE(2) .AND. K1 .EQ. 1) WRITE(6,9004) A,B,PHI
 9004 FORMAT(/' A=',F10.2,'     B=',F10.2,'       PHI=',F8.4)
C
C     ******** CURVES ********************************* CURVES ********
C
      IF(ICURVE.EQ.0 .OR. B.EQ.0.) GO TO 153
      IF(A .LT. 0.) PHI = ABS(PHI-ICURVE*B/ABS(B)*
     1 (K5-1)*DISTP/RADIUS)
      IF(A .GE. 0.) PHI = ABS(PI-PHI-ICURVE*B/ABS(B)*
     1 (K5-1)*DISTP/RADIUS)
      IF(PHI .GT. PI) PHI = 2*PI - PHI
      IF((K4.EQ.2) .OR. (K4.EQ.4)) PHI = PI - PHI
      GO TO 152
C=====>IF ROAD CURVES RECALCULATE PHI
C
C     ******** CURVES ********************************* CURVES ********
C
  153 IF((A.GT.0.) .AND. ((K4.EQ.1) .OR. (K4.EQ.3))) PHI = PI - PHI
      IF((A.LT.0.) .AND. ((K4.EQ.2) .OR. (K4.EQ.4))) PHI = PI - PHI
  152 DPHI = PHI/DEGRA
C
C.....................................................................
C
C     PROD = THE HEIGHT OF THE POINT ABOVE/BELOW A HORIZONTAL PLANE
C            THAT MEETS THE BASE OF THE LUMINAIRE POLE.
C
      PROD = ABS(B*TAN(EPSLN))
      IF((UPHILL .AND. B.LT.0.0) .OR. (.NOT.UPHILL .AND. B.GT.0.0))
     1 PROD = (-1.0)*PROD
      PROD1 = ZL + PROD
      IF(PROD1 .EQ. 0.0) GO TO 146
      GAM = ATAN(ABS(SQRT(A*A+B*B)/(ZL+PROD)))
C       IF PROD1 IS LESS THAN ZERO THE POINT IS ABOVE THE LUMINAIRE
      IF(PROD1 .LT. 0.0) GAM = HAFPI + ATAN(1.0/TAN(GAM))
  146 IF(PROD1 .EQ. 0.0) GAM = HAFPI
C.....................................................................
      DGAM = GAM/DEGRA
      IF(DGAM .GT. 95.) GO TO 143
      CALL GAMPHI(DGAM,DPHI,DIST7,K4)
      DIST1(K5,K4) = DIST7
C...................................................................
C     D = THE DISTANCE FROM THE LUMINAIRE BULB TO THE POINT
C
      D = SQRT((ZL+PROD)**2+A*A+B*B)
C
C     CSGMPR = THE ANGLE BETWEEN D AND THE PERPENDICULAR FROM THE
C              BULB TO THE ROAD SURFACE
C
      CSGMPR = ZL*COS(EPSLN)/D
C.....................................................................
      IF(EPSLN.NE.0. .OR. ICURVE.NE.0) GO TO 148
C
C.....................................................................
C
```

```
C
C  CALCULATIONS FOR VERTICAL ILLUMINATION
C  -----------------------------------------
C
      IF(TRACE(2) .AND. K1.EQ. 1) WRITE (6,111) YL, YP, K1, NXMED
  111 FORMAT (/,2X,'YL, YP, K1, NXMED = ',2F8.2,2I4)
      IF(TRACE(2) .AND. K1 .EQ. 1) WRITE (6,9005) PROD,ZL,PHI,DPHI,
     *                GAM,DGAM,K3,K5,DIST7,D,CSGMPR,EPSLN
 9005 FORMAT (' AT 9005',4X,6F10.4,2I5,4F10.4)
C
      IF(YL.GE.YP .AND. K1.GT.NXMED .OR.
     1 YL.GE.YP .AND. K1.LE.NXMED .AND. REV .OR.
     2 YL.LE.YP .AND. K1.LE.NXMED .AND. .NOT.REV)
     $ GO TO 148
C
C...HP = HORIZONTAL DISTANCE FROM LUMINAIRE TO POINT
C
      HP = SQRT(A*A+B*B)
C
C...SNGMPR = SINE OF CSGMPR
C...SNPHI = SINE OF ANGLE BETWEEN HP AND LINE FROM LUMINAIRE
C             TO OPPOSITE SIDE OF ROADWAY
C
      IF (HP .EQ. 0.) GO TO 148
      SNGMPR = HP/D
      SNPHI = ABS(B)/HP
C
      DIST7V = DIST7*CSGMPR**2*SNGMPR*SNPHI/(ZL*COS(EPSLN))**2
      EPV(K2,K1) = EPV(K2,K1) + DIST7V
C
C.............................................................
C
  148 DIST7 = DIST7*CSGMPR**3/(ZL*COS(EPSLN))**2
      EP(K2,K1) = EP(K2,K1) + DIST7
  143 CONTINUE
  142 CONTINUE
      IF(TRACE(2) .AND. K1 .EQ. 1) WRITE(6,9007) (EP(I,1),I=1,NY)
 9007 FORMAT(' EP( ,46):'/1X,(10F10.4/))
      IF(TRACE(2) .AND. K1 .EQ. 1) WRITE(6,9017) (EPV(I,1),I=1,NY)
 9017 FORMAT(' EPV( ,46):'/1X,(10F10.4/))
C
C...EACH SET OF 'DIST1' CONSISTS OF 26 X 4 VALUES, ONE FOR EACH
C   LUMINAIRE (NO. OF LUM. IS ASSUMED MAXIMUM). EACH SET IS
C   STORED AS ONE RECORD, FOR ONE GRID POINT.  THE RECORDS'
C   ORDER IS IN ACCORDANCE WITH THE ORDER OF THE GRID POINT
C   ENCOUNTERED, I.E. (1,1),(1,2),(1,3) ETC. THESE RECORDS ARE
C   RETRIEVED IN THE SAME ORDER FOR EACH GRID POINT, ONE AT A TIME
C
      WRITE(9) DIST1
C
  141 CONTINUE
  140 CONTINUE
C
C...IF CODE 'LUCODE' = 3 OR 4 , NO LUMINANCE CALCULATION
C
      IF(LUCODE.EQ.3 .OR. LUCODE.EQ.4) GO TO 206
C
      IF(TRACE(2)) WRITE(6,9018)
 9018 FORMAT(//' --- LUMINANCE CALCULATIONS ---')
C
C...DEFINE REFLECTANCE FROM POINT TO DYNAMIC DRIVER POSITION.
C...DO LOOP BASED ON NO. OF LANES IN BOTH ROADWAY
C
      DO 160 K1=1,NC
      REWIND 9
C
C...DO LOOP BASED ON NO. OF DRIVER POSITIONS ON EACH LANE.
C
      NXINT = 1
      NXEND = NX
      IF(NMED .EQ. 0) GO TO 150
      IF(K1 .GT. LANE(1)) GO TO 155
      NXEND = NXMED
      GO TO 150
  155 NXINT = NXMED + MEDIV
      IF(NEW) NXINT = NXMED + 1
      NXEND = NX
  150 DO 165 K2=1,NY
C
C...PROCESS STARTS FROM DRIVER WITH SMALLEST Y
C
      NP = K2
      IF(LANE(1).GE.K1 .AND. (.NOT.REV)) NP = NY + 1 - K2
      XC = XLC(NP,K1)
      YC = YLC(NP,K1)
C
```

```
C
      IF(ICURVE .NE. 0) XC = XLC(K2,K1)
      IF(ICURVE .NE. 0) YC = YLC(K2,K1)
C======> REDEFINITION OF DRIVER POSITIONS FOR CURVES
C
      YP = Y(K2)
C
      IF(NXINT .EQ. 1) GO TO 171
      NXINT1 = NXINT - 1
      DO 173 M=1,NXINT1
  173 READ(9)
C
C...DO LOOP BASED ON NO. OF STRIPS ACROSS THE TOTAL WIDTH
C     OF ROADWAY WHERE DRIVER BELONGS.
C
  171 CONTINUE
      IF(TRACE(2) .AND. K1 .EQ. 1 .AND. K2.LE.3)
     *                 WRITE(6,9008) XC,YC,YP,NXINT,NXEND
 9008 FORMAT('  XC =',F8.2,'  YC =',F8.2,'  YP =',F8.2,'  NXINT =',
     *        I5,'  NXEND =',I5)
C
      DO 166 K3=NXINT,NXEND
      READ(9) DIST1
C
C...TRANSFORM & ROTATE AXIS SO NEW ORIGIN IS AT GRID POINT
C     UNDER EXAMINATION AND NEW Y-AXIS // LINE JOINING GRID POINT
C     AND DRIVER.  THIS NEW SET OF CO-ORDINATES IS FOR FINDING
C     ANGLE BETA ONLY.
C
      XP = X(K3)
C
      IF(ICURVE .NE. 0) XP = X(K3) + DELTAX(K2,K3)
C=====>IF ROAD IS CURVED, ADD DELTAX TO OBTAIN POINT FOR A CURVE
C
      IF(ICURVE .NE. 0) YP = DELTAY(K2,K3)
C=====>IF ROAD IS CURVED, USE DELTAY INSTEAD OF Y
C
      XDIFF = XC - XP
      YDIFF = ABS(YC-YP)
      IF(YDIFF .EQ. 0.) GO TO 170
      THETA = ATAN(ABS(XDIFF/YDIFF))
      IF((YC-YP) .GT. 0.) THETA = PI - ABS(THETA)
      GO TO 172
  170 IF(XDIFF .EQ. 0.) GO TO 166
      THETA = HAFPI
  172 IF(XDIFF .LT. 0.) THETA = -THETA
C
      IF(TRACE(2) .AND. K2.LE.3 .AND. K1.EQ.1 .AND. K3.LE.2)
     *                 WRITE(6,9009) XP,XDIFF,YDIFF,THETA
 9009 FORMAT(' XP =',F8.2,'XDIFF =',F8.2,'  YDIFF =',F8.2,'  THETA =',
     *        F10.4)
C
  175 CONTINUE
C
C...DO LOOP BASED ON ROWS OF LUMINAIRES
C
      DO 167 K5=1,4
      IF(TYPE(K5) .EQ. 0) GO TO 167
      NN = NLU(K5)
C
C...DO LOOP BASED ON NO OF LUMINAIRES/ROW
C
      DO 168 K6=1,NN
      TGAM = 0.
      YL = (YLU(K6,K5)-YP)/COS(EPSLN)
      XL = XLU(K6,K5) - XP
      ZL = ZLU(K6,K5)
      IF(TRACE(2) .AND. K1.EQ.1 .AND. K2.EQ.1 .AND. K3.EQ.1)
     *                 WRITE(6,9010) XL,YL,ZL
 9010 FORMAT('  XL=',F10.2,'  YL=',F10.2,'  ZL=',F10.2)
      IF(ZL .LE. 0.) GO TO 168
C.......................................................................
C
C...YLCHNG = THE DISTANCE ALONG THE ROAD SLOPE FROM THE POLE
C             BASE TO THE PERPENDICULAR TO THE ROAD FROM THE BULB
C
      YLCHNG = ZL*SIN(EPSLN)
      IF(UPHILL .AND. YL.LT.0.) YLCHNG = -YLCHNG
      IF(.NOT.UPHILL .AND. YL.GT.0.0) YLCHNG = -YLCHNG
      N = 1
      IF(YL .LT. 0.0) N = 0
      YL = ABS(YL) + YLCHNG
      IF(N .EQ. 0) YL = -YL
C.......................................................................
```

```
C
      XLNEW = XL*COS(THETA) + YL*SIN(THETA)
      XLNEW = ABS(XLNEW)
      YLNEW = -XL*SIN(THETA) + YL*COS(THETA)
  489 IF(XLNEW .EQ. 0.) GO TO 180
      PHI = ATAN(YLNEW/XLNEW)
      GO TO 185
  180 PHI = HAFPI
      IF(YLNEW .LT. 0.) PHI = -PHI
  185 BET = HAFPI - PHI
C
      TGAM = SQRT(XL*XL+YL*YL)/(ZL*COS(EPSLN))
      IF(TRACE(2) .AND. K1.EQ.1 .AND. K2.EQ.1 .AND. K3.EQ.1)
     *          WRITE(6,9011) XLNEW,YLNEW,PHI,BET,TGAM
 9011 FORMAT('  XLNEW =',F10.2,'  YLNEW =',F10.2,'  PHI =',F10.4,
     *   '  BET =',F10.4,'  TGAM =',F10.4)
      IF(TGAM .GT. 12.) GO TO 168
      EPI = DIST1(K6,K5)
C
C...ZLA = THE LENGTH OF THE PERPENDICULAR FROM THE BULB TO THE ROAD
C
      ZLA = ZL*COS(EPSLN)
      CALL BETGAM(BET,TGAM,REF7,EPI,ZLA)
      REF(K2,K3) = REF(K2,K3) + REF7
C
C
  168 CONTINUE
  167 CONTINUE
  166 CONTINUE
      IF(NXEND .EQ. NX) GO TO 165
      NXEND1 = NXEND + 1
C
      DO 174 M=NXEND1,NX
  174 READ(9)
C
  165 CONTINUE
      WRITE(10) REF
C
      DO 176 M=1,NX
      DO 176 K=1,NY
  176 REF(K,M) = 0.
C
      IF(TRACE(2) .AND. K1.EQ.1) WRITE(6,9012)
 9012 FORMAT(' ARRAY REF SET TO ZERO')
  160 CONTINUE
C
  206 L1 = 1
      DO 190 KO=1,2
      IF(LANE(KO) .EQ. 0) GO TO 190
      LN = LANE(KO) + L1 - 1
      IF(LN .EQ. 0) GO TO 195
C
C...DO LOOP BASED ON NO. OF LANES
C
      DO 200 K1=L1,LN
C
C...DO LOOP BASED ON NO. OF DRIVER POSITION ON EACH LANE CENTER LINE.
C
      DO 201 K2=1,NY
      XC = XLC(K2,K1)
      YC = YLC(K2,K1)
C
      IF(TRACE(2) .AND. K2.LE.2) WRITE(6,9013) XC,YC
 9013 FORMAT(' XC =',F10.2,'  YC =',F10.2)
C
C...DO LOOP BASED ON 4 ROWS OF LUMINAIRES.
C
      DO 202 K3=1,4
      IF(TYPE(K3) .EQ. 0) GO TO 202
      TYPEK4 = IRINUX(K3)
      IF(K3 .EQ. 1) GO TO 310
      IF(IRINUX(K3-1) .EQ. TYPEK4) GO TO 320
  310 READ(11'TYPEK4) (GAMA(N),(DIST(M,N),M=1,37),N=1,29)
      IF(TRACE(2) .AND. K2.LE.2)
     *          WRITE(6,9014) (GAMA(N),(DIST(M,N),M=1,37),N=1,29)
 9014 FORMAT(//' GAMA                  DIST(1-29)'/(1X,
     1        F8.4,8X,10F9.4/2(17X,10F9.4/),17X,7F9.4))
  320 NN = NLU(K3)
      IF(TRACE(2) .AND. K2.LT.3) WRITE(6,9015) NN
 9015 FORMAT(//' NN =',I6)
C
C...DO LOOP BASED ON MAX. NO. OF LUMINAIRES ON EACH ROW.
C
```

```
      DO 203 K4=1,NN
      EVDVB = 0.
      YL = YLU(K4,K3)
      XL = XLU(K4,K3)
      ZL = ZLU(K4,K3)
      IF(TRACE(2) .AND. K4.EQ.1 .AND. K2.LT.3)
     *                WRITE(6,9016) XL,YL,ZL,XC,YC,EPSLN
 9016 FORMAT(' XL=',F10.2,'  YL=',F10.2,'  ZL=',F10.2,'  XC=',F10.2,
     *       '  YC=',F10.2,'  EPSLN =',F10.4)
      IF(YL.LT.YC .AND. KO.EQ.2) GO TO 203
      IF(YL.LT.YC .AND. KO.EQ.1 .AND. REV) GO TO 203
      IF(YL.GT.YC .AND. KO.EQ.1 .AND. .NOT.REV) GO TO 203
      A = XL - XC
      B = YL - YC
C.............................................................................
      IF(EPSLN .EQ. 0) GO TO 322
      RDANGL = COS(EPSLN)
      IF(RDANGL .EQ. 0.0) GO TO 203
      NY1 = K2
      IF(KO.EQ.1 .AND. .NOT.REV) NY1 = NY - K2 + 1
      Y1 = Y(NY1)
      ICASE = 0
      IF((REV .OR. KO.EQ.2) .AND. YL.GT.Y1) ICASE = 1
      IF((REV .OR. KO.EQ.2) .AND. YL.LT.Y1) ICASE = 2
      IF(ICASE.EQ.1 .OR. (.NOT.REV .AND. KO.EQ.1 .AND. YL.LT.Y1))
     1 B = ABS(YL-Y1)/COS(EPSLN) + FM90
      IF(ICASE.EQ.2 .OR. (.NOT.REV .AND. KO.EQ.1 .AND. YL.GT.Y1))
     1 B = -ABS(YL-Y1)/COS(EPSLN) + FM90
  322 HYP = SQRT(A*A+(B*COS(EPSLN))**2)
      HTDRV1 = HTDRIV/COS(EPSLN)
C
C...ZLCHNG = THE DISTANCE THE POINT IS ABOVE/BELOW A HORIZONTAL
C             PLANE THAT RUNS THROUGH THE BASE OF THE LUMINAIRE POLE
C
      ZLCHNG = ABS(B)*SIN(EPSLN)
      IF(KO.EQ.1 .AND. UPHILL .AND. .NOT.REV) ZLCHNG = -ZLCHNG
      IF(.NOT.UPHILL .AND. (REV .OR. KO.EQ.2)) ZLCHNG = -ZLCHNG
      HLC = ZL + ZLCHNG - HTDRV1
C
C...YZ IS THE DISTANCE FROM THE BULB TO A POINT HTDRIV/COS(EPSLN)
C    ABOVE THE MIDDLE OF THE LANE OBSERVED DIRECTLY OPPOSITE
C    THE LUMINAIRE
C
      YZ = SQRT((ZL-HTDRV1)**2+A*A)
      IF(TRACE(2) .AND. K4.EQ.1 .AND. K2.LT.3)
     *         WRITE(6,9020) A,B,HTDRV1,HYP,YZ,HLC,ZLCHNG
 9020 FORMAT(/1X,7F10.2/)
C.............................................................................
      IF( B .EQ. 0.) GO TO 203
C
C..PLANE ANGLE IS USED TO CHECK DVB ANGLE AS INDICATED IN THE CIE REPORT
C
      R = SQRT(HYP*HYP+HLC*HLC)
      IF(R .EQ. 0.0) GO TO 203
C.............................................................................
      ANGO = ABS(ATAN(HLC/(B*COS(EPSLN)))) + EPSLN
      IF(ZLCHNG .LT. 0.0) GO TO 330
      ANGO = ANGO - EPSLN*2.0
  330 CONTINUE
      IF(TRACE(2) .AND. K4.EQ.1 .AND. K2.LT.3) WRITE(6,9021) ANGO,ANGLIM
 9021 FORMAT(1X,2F12.4/)
C.............................................................................
      IF(ANGO .GT. ANGLIM) GO TO 203
      IF(HYP .EQ. 0.) GO TO 203
      ANGDVB = ABS(ATAN(HLC/HYP))
      IF(EPSLN .NE. 0.0) GO TO 208
      THETA = ARCOS(ABS(B/R))
      GO TO 209
  208 CONTINUE
C
C...THETA IS CALCULATED USING THE COSINE LAW
C
      THETA = ARCOS(ABS((B*B+R*R-YZ*YZ)/(2*B*R)))
  209 CONTINUE
C
      GAM = HAFPI - ANGDVB
C.............................................................................
      ZLCNG1 = 0.
      IF(ZLCHNG .LT. 0.) ZLCNG1 = ABS(ZLCHNG) + HTDRV1
C        IF ZLCNG1 IS GREATER THAN ZL THE DRIVER IS ABOVE THE LUMINAIRE
      IF(ZLCNG1 .GT. ZL) GAM = ANGDVB + HAFPI
      IF(ZLCNG1 .EQ. ZL) GAM = HAFPI
C.............................................................................
      DGAM = GAM/DETORA
      IF(TRACE(2) .AND. K4.EQ.1 .AND. K2.LT.3)
     *               WRITE(6,9022) THETA,ANGDVB,GAM,DGAM
 9022 FORMAT(' THETA=',F12.4,'  ANGDVB=',F12.4,'  GAM=',F12.4,
     *       '  DGAM=',F12.4)
```

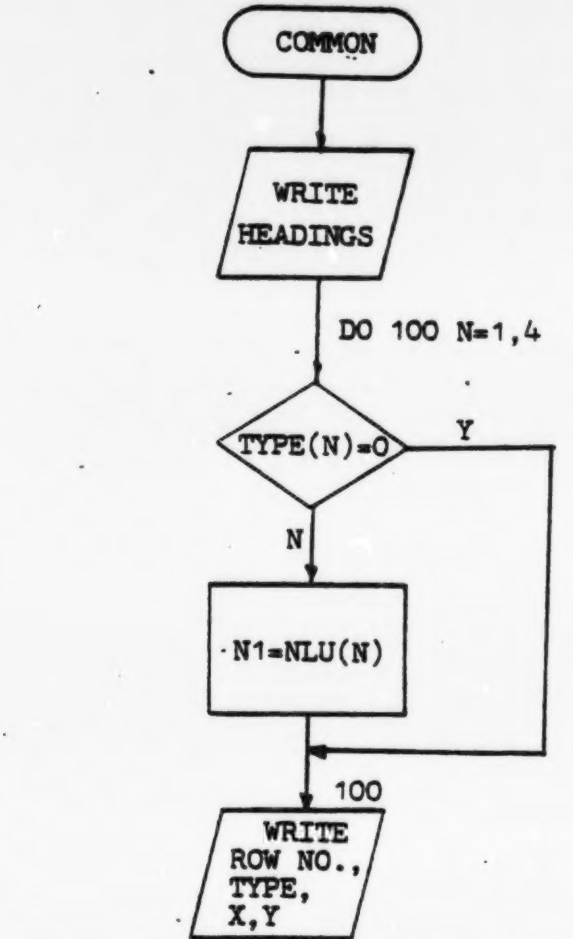
```
      IF(DGAM .GT. 95.) GO TO 203
      IF(A .EQ. 0.) GO TO 205
      PHI = ABS(ATAN(B*COS(EPSLN)/A))
  205 IF(A .EQ. 0.) PHI = HAFPI
      IF(A.EQ.0. .AND. B.EQ.0.0) PHI = 0.
C
      IF(ICURVE .EQ. 0) GO TO 224
C                           ***********************
C                           *                     *
C     *********************** CURVE DVB BLOCK     ***************************
C     *                     *                     *                         *
C     *                     ***********************                         *
C     *                                                                     *
  290           IF(A .LT. 0.) PHI = ABS(PHI-ICURVE*B/ABS(B)                 *
     *           *(K4-1)*DISTP/RADIUS)
C     *
                IF(A .GE. 0.) PHI = ABS(PI-PHI-ICURVE*B/ABS(B)              *
     *           *(K4-1)*DISTP/RADIUS)
C     *
                IF(PHI .GT. PI) PHI = 2*PI - PHI                            *
C     *
                IF((K3.EQ.2) .OR. (K3.EQ.4)) PHI = PI - PHI                 *
C     *
                GO TO 225                                                   *
C     *
C     *                                                                     *
C     ***********************************************************************
C
  224 IF((A.GT.0.) .AND. ((K3.EQ.1[illegible]R. (K3.EQ.3))) PHI = PI - PHI
      IF((A.LT.0.) .AND. ((K3.EQ.2[illegible]R. (K3.EQ.4))) PHI = PI - PHI
C
C
      IF(ICURVE .EQ. 0) GO TO 223
C
C    ************** CURVE DVB BLOCK CONTINUED **********************
C    *                                                             *
C    *                                                             *
  225          IF(KO .EQ. 1) KAPPA = ABS((K4-1)*DISTP                *
     *          /RADIUS-ATAN(ABS(YC)/(RADIUS-ICURVE*
     *          (ABS(XC)-RDWAY(1)/2-MDIV(1)*RDWAY(1)
     *          /LANE(1)/NSTRIP))))
C    *
               IF(KO .EQ. 2) KAPPA = ABS((K4-1)*DISTP                *
     *          /RADIUS-ATAN(ABS(YC)/(RADIUS-ICURVE*
     *          (ABS(XC)-RDWAY(1)/2-MDIV(1)*RDWAY(1)
     *          /LANE(1)/NSTRIP)+WMED)))
C    *
C    *     ======>KAPPA IS THE ANGLE BETWEEN THE LUMINAIRE              *
C    *                    AND THE DRIVER POSITION                       *
C    *                                                                  *
               MU = HAFPI - KAPPA + AMUA/2                              *
C    *
               BPRIME = ABS(HYP*SIN(PHI)/SIN(PI-MU))                    *
C    *     ======>BPRIME IS 'B' FOR A CURVE
C    *                                                                  *
               APRIME = ABS(HYP*SIN(MU-PHI)/SIN(PI-MU))                 *
C    *     ======>APRIME IS 'A' FOR A CURVE
C    *                                                                  *
               THETA = ARCOS((R*R-APRIME**2-HLC**2+BPRIME**2)           *
     *                        /2/BPRIME/R)
C    *     ======>BECAUSE THE DRIVERS LINE OF SIGHT IS
C    *                NOT PARALLEL TO THE CURB ON CURVES,               *
C    *                THETA IS FOUND USING THE COSINE LAW               *
C    *                                                                  *
C    ********************************************************************
C
C
  223 DPHI = PHI/DETORA
      CALL GAMPHI(DGAM,DPHI,DIST7,K3)
      DTHETA = THETA/DETORA
C
C
      EV = DIST7*COS(THETA)/(R*R)
      EVDVB = EV*PI10
      IF(DTHETA .NE. 0.) EVDVB = EVDVB/(DTHETA*DTHETA)
      DVB(K2,K1) = DVB(K2,K1) + EVDVB
      IF(TRACE(2) .AND. K4.EQ.1 .AND. K2.LT.3)
     *             WRITE(6,9023) PHI,DPHI,DTHETA,EV,EVDVB,DVB
 9023 FORMAT(' PHI=',F12.4,'  DPHI=',F12.4,'  DTHETA=',F12.4,'  EV=',
     *       F10.2,'  EVDVB=',F10.2,'  DVB=',F10.2)
  203 CONTINUE
  202 CONTINUE
  201 CONTINUE
  200 CONTINUE
  195 L1 = LN + 1
  190 CONTINUE
```

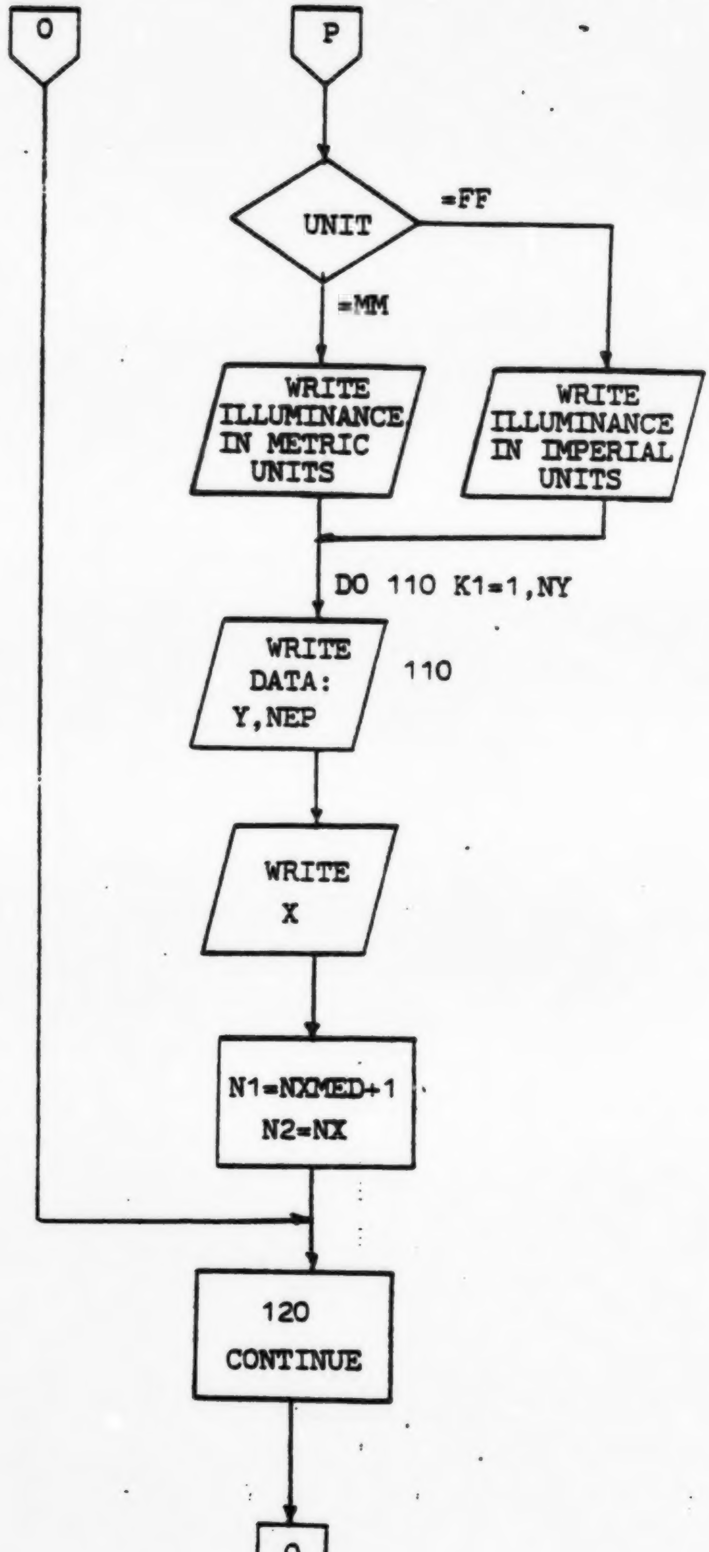
```
C
C...FIND AVERAGES AND UNIFORMITY RATIOS
C
      IF(NEW) GOTO 1000
      CALL AVMAMI(EP,EVAVG,EVMAX,EVMIN,EVAVMI,EVMAAV,EVMAMI,1)
      IF(EPSLN.EQ.0. .AND. ICURVE.EQ.0)
     1 CALL AVMAMI(EPV,EPVAVG,EPVMAX,EPVMIN,EPVAMN,EPVMXA,EPVMXM,1)
      IF(LUCODE.EQ.3 .OR. LUCODE.EQ.4 ) GO TO 9999
      REWIND 10
      CALL AVMAMI(REF,REFAVG,REFMAX,REFMIN,REAVMI,REMAAV,REMAMI,0)
      REWIND 10
      CALL AVMAMI(REF,RAVG,RMAX,RMIN,RAVMI,RMAAV,RMAMI,2)
      GOTO 9999
C
 1000 CALL AVG2(EP,EVAVG,EVMAX,EVMIN,EVAVMI,EVMAAV,EVMAMI,EVAVGS,EVMAXS,
     *         EVMINS,EVAVMS,EVMAVS,EVMAMS,EVAVGM,EVMAXM,EVMINM,EVAVMM,
     *         EVMAVM,EVMAMM)
      IF(EPSLN.EQ.0. .AND. ICURVE.EQ.0)
     1 CALL AVG2(EPV,EPVAVG,EPVMAX,EPVMIN,EPVAMN,EPVMXA,EPVMXM,PVAVGS,
     *  PVMAXS,PVMINS,PVAVMS,PVMAVS,PVMAMS,PVAVGM,PVMAXM,PVMINM,PVAVMM,
     *         PVMAVM,PVMAMM)
      IF(LUCODE.EQ.3 .OR. LUCODE.EQ.4 ) GO TO 9999
      REWIND 10
      CALL AVG1(REF,REFAVG,REFMAX,REFMIN,REAVMI,REMAAV,REMAMI,0)
      REWIND 10
      CALL AVG1(REF,RAVG,RMAX,RMIN,RAVMI,RMAAV,RMAMI,2)
 1010 IF(.NOT. TRACE(2)) GOTO 9999
      WRITE(6,9030)
 9030 FORMAT(//'      EVAVG,EVMAX,EVMIN,EVAVMI,EVMAAV,EVMAMI'/)
      WRITE(6,9031) EVAVG,EVMAX,EVMIN,EVAVMI,EVMAAV,EVMAMI
 9031 FORMAT(6(8F12.3/))
      WRITE(6,9032)
 9032 FORMAT(//'      EPVAVG,EPVMAX,EPVMIN,EPVAMN,EPVMXA,EPVMXM'/)
      WRITE(6,9031) EPVAVG,EPVMAX,EPVMIN,EPVAMN,EPVMXA,EPVMXM
      WRITE(6,9033)
 9033 FORMAT(//'      REFAVG,REFMAX,REFMIN,REAVMI,REMAAV,REMAMI'/)
      WRITE(6,9031) REFAVG,REFMAX,REFMIN,REAVMI,REMAAV,REMAMI
      WRITE(6,9034)
 9034 FORMAT(//'      RAVG,RMAX,RMIN,RAVMI,RMAAV,RMAMI'/)
      WRITE(6,9031) RAVG,RMAX,RMIN,RAVMI,RMAAV,RMAMI
 9999 RETURN
      END
```

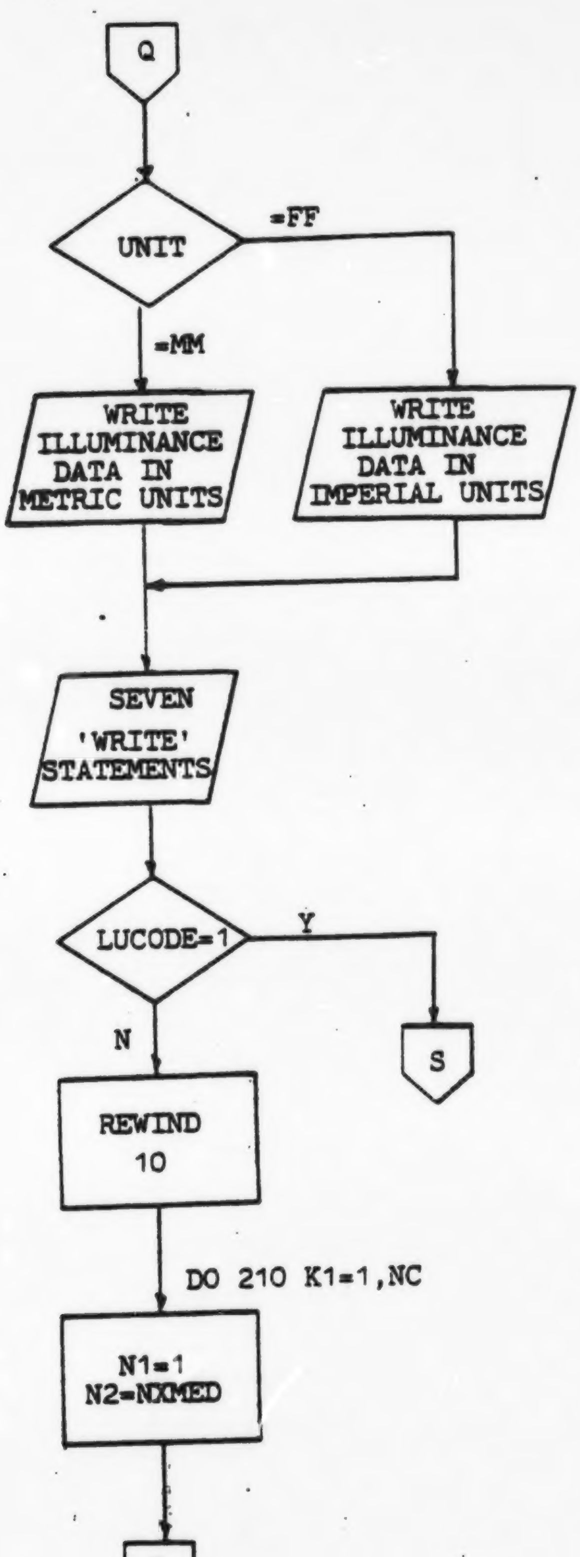
D.5/ OUTPUT Subroutine Flowchart and Program Listing

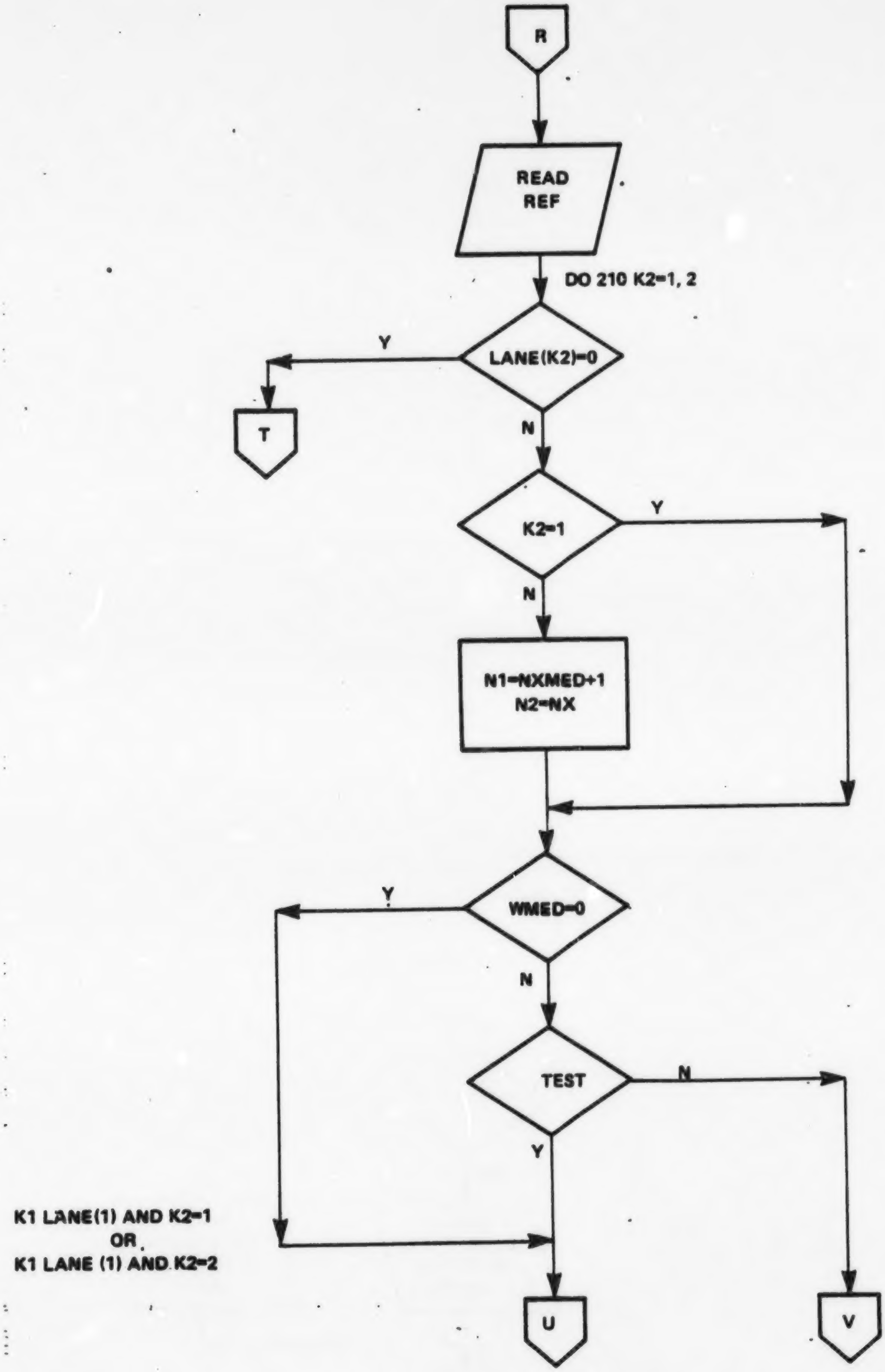
The function of this routine is to print the calculated illuminance and luminance values at each grid point and disability veiling brightness (DVB) at each driver location. Also, this routine prints the summarized ratios of design parameters for each lane and roadway. (See sample output in Appendix C.)

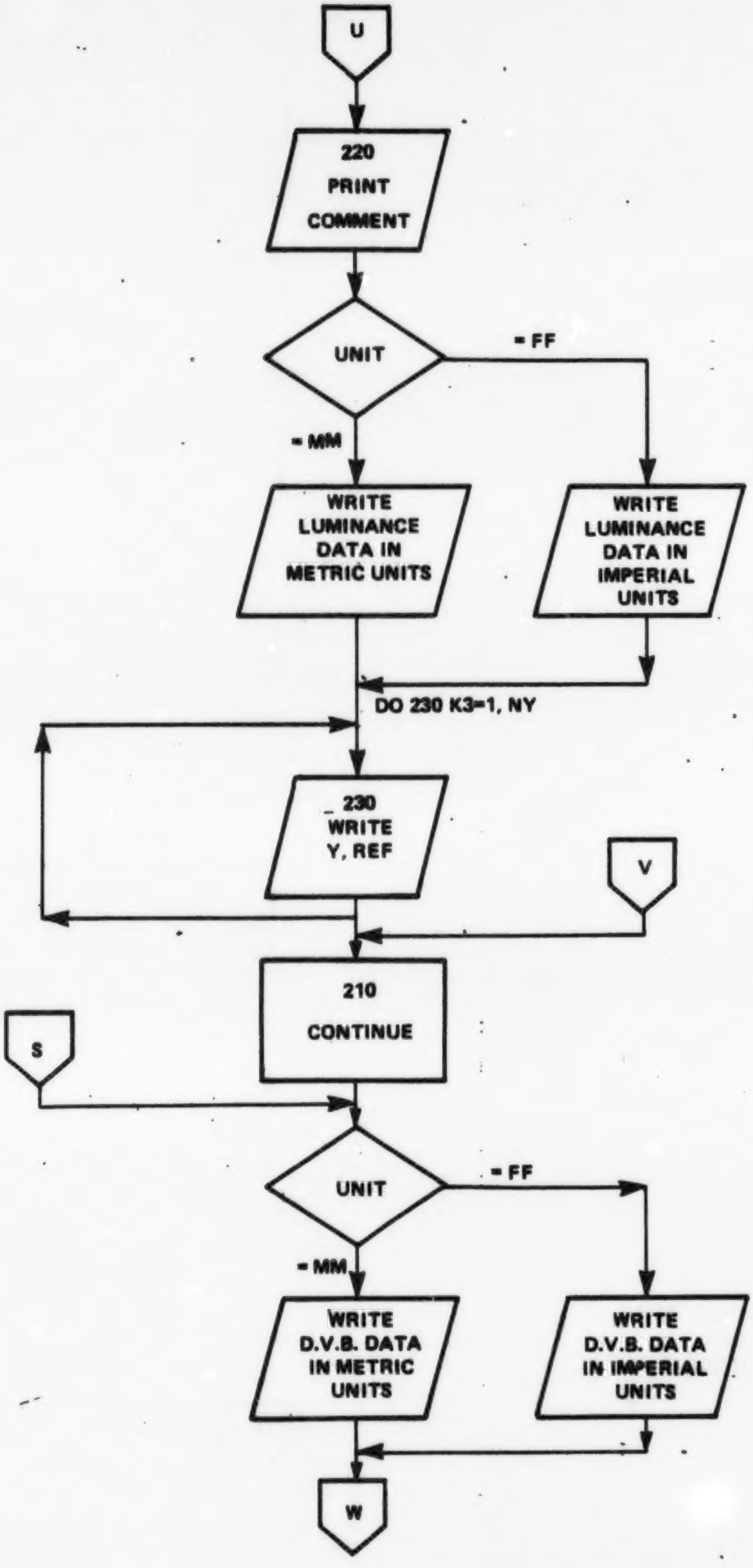
FLOWCHART

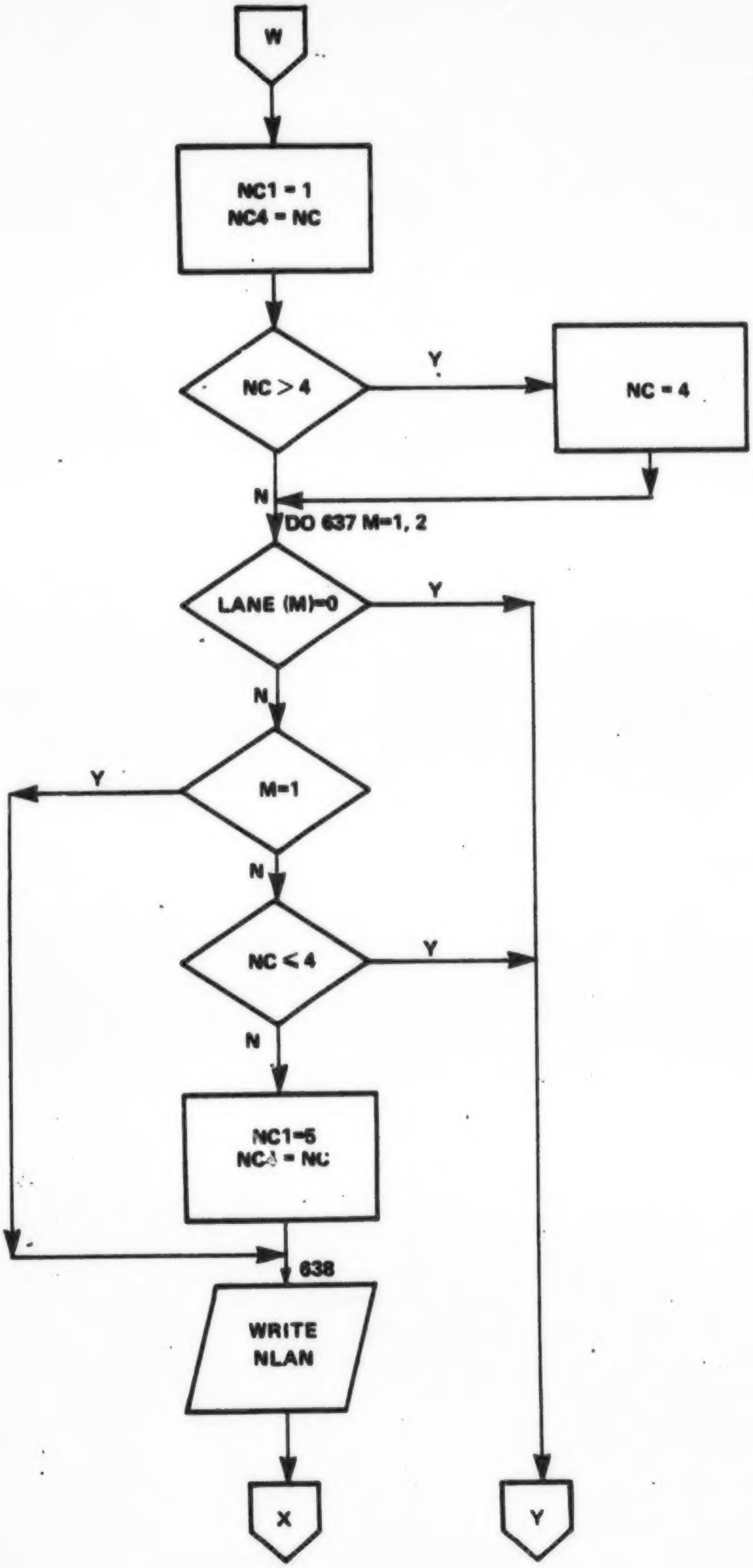

COMMON
WRITE HEADINGS
DO 100 N=1,4
TYPE(N)=0
Y
N
N1=NLU(N)
100
WRITE ROW NO., TYPE, X,Y
DO 606 K1=1,NX
DO 606 K2=1,NY
NEP(K2,K1)= IFIX(EP(K2,K1) *100)
N1=1;N2=NXMED
606
DO 120 N=1,2
Y
LANE(N)=0
N
O
P

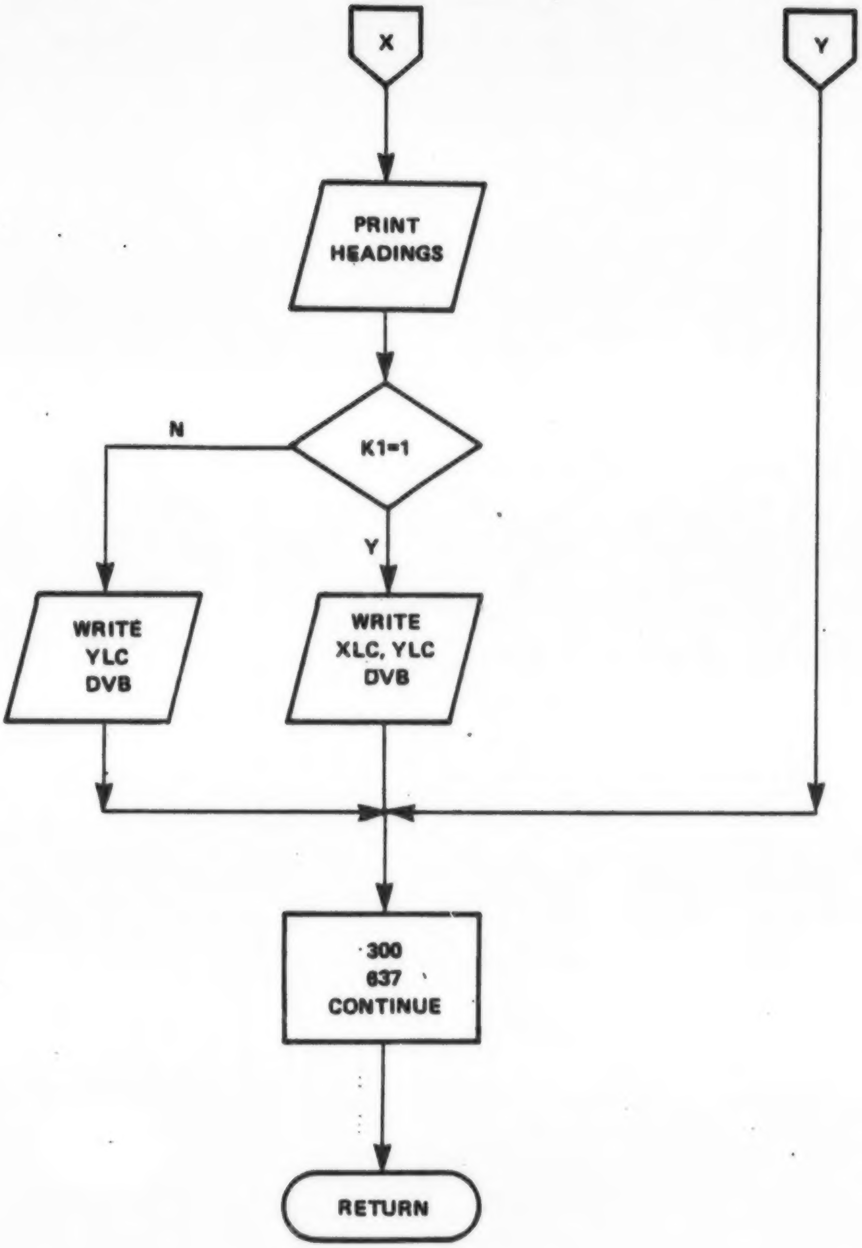

O
P
UNIT
=FF
=MM
WRITE ILLUMINANCE IN METRIC UNITS
WRITE ILLUMINANCE IN IMPERIAL UNITS
DO 110 K1=1,NY
WRITE DATA: Y,NEP
110
WRITE X
N1=NXMED+1
N2=NX
120 CONTINUE
Q


Q
UNIT
=FF
=MM
WRITE ILLUMINANCE DATA IN METRIC UNITS
WRITE ILLUMINANCE DATA IN IMPERIAL UNITS
SEVEN 'WRITE' STATEMENTS
LUCODE=1
Y
N
S
REWIND 10
DO 210 K1=1,NC
N1=1
N2=NXMED
R


R
READ
REF
DO 210 K2=1, 2
LANE(K2)=0
Y
N
T
K2=1
Y
N
N1=NXMED+1
N2=NX
WMED=0
Y
N
TEST
N
Y
K1 LANE(1) AND K2=1
OR
K1 LANE (1) AND K2=2
U
V


U
220
PRINT
COMMENT
UNIT
= FF
= MM
WRITE
LUMINANCE
DATA IN
METRIC UNITS
WRITE
LUMINANCE
DATA IN
IMPERIAL
UNITS
DO 230 K3=1, NY
230
WRITE
Y, REF
V
210
CONTINUE
S
UNIT
= FF
= MM
WRITE
D.V.B. DATA
IN METRIC
UNITS
WRITE
D.V.B. DATA
IN IMPERIAL
UNITS
W


W
NC1 = 1
NC4 = NC
NC > 4
Y
NC = 4
N
DO 637 M=1, 2
LANE (M)=0
Y
N
M=1
Y
N
NC < 4
Y
N
NC1=5
NC4 = NC
638
WRITE
NLAN
X
Y


X
Y
PRINT HEADINGS
K1=1
N
Y
WRITE YLC DVB
WRITE XLC, YLC DVB
300
637
CONTINUE
RETURN

```
      SUBROUTINE OUTPUT(NEW,*)
C
C     *************************************************************
C
      COMMON /ONE/  DISTP,      DVBANG(3),FMAIN(4),  HT(4),      KDIV,
     1              LANE(2),    LOSTAT(4),MDIV(2),   NLR(4),     NLUA,
     2              NSTRIP,     OFFSET(4),PATERN,    PAVTYE,     QQ,
     3              RDWAY(2),   REV,       TYPE(4),  UNIT,       USTAT(4),
     4              WMED,       LUCODE,    MANUF,    RADIUS,     ICURVE,
     5              C,          IRINDX(4),EPSLN,     UPHILL,     WLANE(2,4),
     6              WSHOLD(2),MEDIV,       RDWD(2)
C
      COMMON /TWO/  STAT(4),    X(46),     XLC(91,8),  XLU(26,4),XSTRIP(2),
     1              PAVE(4),    Y(91),     YLC(91,8),  YLU(26,4),ZLU(26,4),
     2              NC,         NLU(4), NX,            NXMED,     NY,
     3              DELTAX(91,46),         DELTAY(91,46),
     4              XSSTRP(2),XMSTRP, NLX,             NMX
C
C
      COMMON /THREE/BETA(20),  DIST(37,29),  DVM(91,8),    EP(91,46),
     1       GAMA(29),         REF(91,46),   REFLEC(20,49),    EVAVG(10),
     2       EVMAX(10),        EVMIN(10),    EVAVMI(10),       EVMAAV(10),
     3       EVMAMI(10),       REFAVG(10),   REFMAX(10),       REFMIN(10),
     4       REAVMI(10),       REMAAV(10),   REMAMI(10),       NEP(91,46),
     5       EPV(91,46),       EPVAVG(10),   EPVMAX(10),       EPVMIN(10),
     6       EPVAMN(10),       EPVMXA(10),   EPVMXM(10),       NEPV(91,46),
     7       EVAVGS(2),        EVMAXS(2),    EVMINS(2),        EVAVMS(2),
     8       EVMAVS(2),        EVMAMS(2),    EVAVGM,           EVMAXM,
     9       EVMINM,           EVAVMM,       EVMAVM,           EVMAMM,
     +       PVAVGS(2),        PVMAXS(2),    PVMINS(2),        PVAVMS(2),
     1       PVMAVS(2),        PVMAMS(2),    PVAVGM,           PVMAXM,
     2       PVMINM,           PVAVMM,       PVMAVM,           PVMAMM
C
      COMMON /FOUR/ RAVG(10),RMAX(10),RMIN(10),
     1              RMAAV(10),RAVMI(10),RMAMI(10)
      COMMON /FIVE/ FMNEW
C
      COMMON /CONST/DETURA, PI, HAFPI, PI10, HTDRIV, FM90, ANGLIM,
     1              TYPNO, NMANU, NOPN, SILMP, TRACE
C
      LOGICAL         SILMP,NEW
      LOGICAL*1       TRACE(3)
C
C
      DIMENSION EVAVG2(2), EVMAX2(2), EVMIN2(2), EVMXA2(2), EVAMN2(2),
     1          EVMXM2(2), EPVAV2(2), EPVMX2(2), EPVMN2(2), EPVMA2(2),
     2          EPVAM2(2), EPVMM2(2), REAVG2(2), REMAX2(2), REMIN2(2),
     3          REMXA2(2), REAMN2(2), REMXM2(2), LANES(2),  YSLOP(91),
     4          YLC1(91,8), YLSLOP(26,4), YLCSLP(91,8)
      DIMENSION RAVG2(2),RMAX2(2),RMIN2(2),RMXA2(2),RAMN2(2),RMXM2(2)
      DIMENSION CHARS(6), LR(2), NLAN(8)
      DIMENSION DVBAVG(8), DVBMAX(8), LOC(8), WRSAVG(8), SUMAB(8),
     1          DVBLAV(8), DMLAV(8), COUNT(2),COUNTV(2)
C
      INTEGER   TYPE, C
      REAL      LL, MM
      LOGICAL   REV, PRINT
C   —
      DATA CHARS/'AVG','MAX','MIN','MAX/','AVG/','    '/
      DATA LR/'L','R'/, FF/'F'/, MM/'M'/
      DATA NLAN/'1','2','3','4','5','6','7','8'/
      DATA LANO1/'LANE'/, LANO2/' NO.'/, DASH/'————'/
      DATA XYDVB1/'X    '/,XYDVB2/'    Y'/,XYDVB3/'DVB '/,XYDVB4/' X ='/
      DATA DVB1/'LUM '/, DVB2/'FOR '/, DVB3/' *  '/
C
      COUNT(1)  = 0.
      COUNT(2)  = 0.
      COUNTV(1) = 0.
      COUNTV(2) = 0.
      EVMAX2(1) = -99999
      EVMAX2(2) = -99999
      EVMIN2(1) = +99999
      EVMIN2(2) = +99999
      EPVMX2(1) = -99999
      EPVMX2(2) = -99999
      EPVMN2(1) = +99999
      EPVMN2(2) = +99999
      REMAX2(1) = -99999
      REMAX2(2) = -99999
      REMIN2(1) = +99999
      REMIN2(2) = +99999
      RMAX2(1)  = -99999
      RMAX2(2)  = -99999
      RMIN2(1)  = +99999
      RMIN2(2)  = +99999
      EVAVG2(1) =  0
      EVAVG2(2) =  0
      EPVAV2(1) =  0
      EPVAV2(2) =  0
      REAVG2(1) =  0
      REAVG2(2) =  0
      RAVG2(1)  =  0
      RAVG2(2)  =  0
C
      IF(EPSLN .NE. 0.) GO TO 80
      WRITE(6,600)
  600 FORMAT('1','OUTPUT',/,' ------',
     1      //,' N.B. THE FIRST LUMINAIRE POSITION CORRESPONDS TO Y=0.'
     2      ,/,T7,'THE LEFT MOST GRID LINE CORRESPONDS TO X=0.',
     3      //,T42,'LUMINAIRE CO-ORDINATES',/,T42,22('-'),//)
   80 IF(EPSLN .NE. 0.) WRITE(6,599)
  599 FORMAT('1','OUTPUT'/' ------',//' N.B. THE FIRST LUMINAIRE',
     1      ' POSITION CORRESPONDS TO Y=0. Y-SLOP = Y-HOR ',
     2      'DIVIDED BY THE COSINE OF THE ANGLE OF THE ROAD SLOPE.'
     3      //T42,'LUMINAIRE CO-ORDINATES'/T42,22('-')//)
C*************CURVES***************CURVES***************CURVES*************
C
C=======> REDEFINE CO-ORDINATES FOR OUTPUT IF ROAD CURVES
C
      IF(ICURVE .EQ. 0) GO TO 123
C
      IF(RDWAY(2) .NE. 0) DISTP = DISTP*(RADIUS-ICURVE*(WMED/2.
     1 +RDWAY(1)/2.))/RADIUS
      IF(RDWAY(2) .NE. 0) FMNEW = FMNEW*(RADIUS-ICURVE*(WMED/2.
     1 +RDWAY(1)/2.))/RADIUS
C=====> CURVE STATEMENTS
C
      FM90 = FMNEW
      I123 = ICURVE
      ICURVE = 0
      CALL COORD
      ICURVE = I123
C
C*************CURVES***************CURVES***************CURVES*************
  123 CONTINUE
      DO 100 N=1,4
      IF(TYPE(N) .EQ. 0) GO TO 100
      N1 = NLU(N)
C.........................................................................
C     YLSLOP IS LUMINAIRE ORDINATE ON SLOPE
      IF(EPSLN .EQ. 0.) GO TO 95
      DO 90 I=1,N1
   90 YLSLOP(I,N) = YLU(I,N)/COS(EPSLN)
      WRITE(6,602) NLR(N), TYPE(N), XLU(1,N), (YLU(I,N),I=1,N1)
  602 FORMAT(' ROW NO.',I2,T15,'TYPE=',I3,T26,'X=',F6.2,/,
     1        T21,'Y-HOR =',2(T28,13F8.2,/),/)
      WRITE(6,604) (YLSLOP(I,N),I=1,N1)
  604 FORMAT(T21,'Y-SLOP=',2(T28,13F8.2,/),/)
      GO TO 100
C.........................................................................
   95 WRITE(6,605) NLR(N), TYPE(N), XLU(1,N), (YLU(I,N),I=1,N1)
  605 FORMAT(' ROW NO.',I2,T15,'TYPE=',I3,T26,'X=',F6.2,/,
     1        T26,'Y=',2(T28,13F8.2,/),/ )
  100 CONTINUE
C
C
      IF(ICURVE .NE. 0) WRITE(6,303)
  303 FORMAT('0','Y CO-ORDINATES ARE MEASURED ALONG THE CENTER',
     1 ' LINE OF THE HIGHWAY',/T2,'X CO-ORDINATES ARE MEASURED ',
     2 'ACROSS THE HIGHWAY, BEGINNING AT THE LEFTMOST POINT OF THE',
     3 ' LHS SHOULDER')
C
C
      DO 606 K1=1,NX
      DO 606 K2=1,NY
  606 NEP(K2,K1) = IFIX(EP(K2,K1)*100.)
C
      IF(EPSLN.NE.0. .OR. ICURVE.NE.0) GO TO 608
      DO 607 K1=1,NX
      DO 607 K2=1,NY
  607 NEPV(K2,K1) = IFIX(EPV(K2,K1)*100.)
  608 CONTINUE
C
      N1 = 1
      N2 = NXMED
C
      IF(LUCODE.EQ.2 .OR. LUCODE.EQ.4) GO TO 900
C
      DO 120 N=1,2
      IF(LANE(N) .EQ. 0) GO TO 120
```

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C.....................................................................
      IF(EPSLN .EQ. 0.) GO TO 109
      IF(UNIT .EQ. MM) WRITE(6,610) LR(N)
  610 FORMAT('1',T40,'INCLINED ILLUMINANCE FOR ',A1,'.M.S.ROADWAY',
     1       /,T40,38('-'),/,T53,'UNIT=LUX X100.',//)
      IF(UNIT .EQ. FF) WRITE(6,6610) LR(N)
 6610 FORMAT('1',T40,'INCLINED ILLUMINANCE FOR ',A1,'.M.S.ROADWAY',
     1       /,T40,38('-'),/,T49,'UNIT=(LUMEN/FT.SQ.)X100.',//)
      DO 105 K1=1,NY
  105 YSLOP(K1) = Y(K1)/COS(EPSLN)
      DO 108 K1=1,NY
      WRITE(6,611) Y(NY-K1+1), YSLOP(NY-K1+1), (NEP((NY-K1+1),K2),
     1             K2=N1,N2)
  611 FORMAT(1X,F6.1,2X,F6.1,' I',19I6,/,17X,19I6,/)
  108 CONTINUE
      WRITE(6,617) (X(K3),K3=N1,N2)
  617 FORMAT(T17,'+',114('-'),/,
     1        T3,'Y-HOR   Y-SLOP/',/,
     2        T15,'/X',2X,19F6.1,/,18X,19F6.1//)
      GO TO 115
C.....................................................................
  109 CONTINUE
      IF(UNIT .EQ. MM) WRITE(6,612) LR(N)
  612 FORMAT('1',T40,'HORIZONTAL ILLUMINANCE FOR ',A1,'.M.S.ROADWAY',
     1       /,T40,40('-'),/,T53,'UNIT=LUX X100.',//)
      IF(UNIT .EQ. FF) WRITE(6,6612) LR(N)
 6612 FORMAT('1',T40,'HORIZONTAL ILLUMINANCE FOR ',A1,'.M.S.ROADWAY',
     1       /,T40,40('-'),/,T49,'UNIT=(LUMEN/FT.SQ.)X100.',//)
      DO 110 K1=1,NY
      WRITE(6,616) Y(NY-K1+1), (NEP((NY-K1+1),K2),K2=N1,N2)
  616 FORMAT(1X,F7.2,' I ',19I6,/,11X,19I6,/)
  110 CONTINUE
C
      WRITE(6,620) (X(K3),K3=N1,N2)
      IF(ICURVE .NE. 0) WRITE(6,303)
  620 FORMAT(T10,'+',120('-'),/,T7,'Y /',/,T7,' /X',2X,19F6.1,
     1       /,12X,19F6.1,//)
      IF(EPSLN.NE.0. .OR. ICURVE.NE.0) GO TO 115
C
C.....................................................................
C *** VERTICAL ILLUMINANCE OUTPUT
C
      IF(UNIT .EQ. MM) WRITE(6,613) LR(N)
  613 FORMAT('1',T40,'VERTICAL ILLUMINANCE FOR ',A1,'.M.S.ROADWAY',
     1       /,T40,38('-'),/,T51,'UNIT=LUX X100.',//)
      IF(UNIT .EQ. FF) WRITE(6,6613) LR(N)
 6613 FORMAT('1',T40,'VERTICAL ILLUMINANCE FOR ',A1,'.M.S.ROADWAY',
     1       /,T40,38('-'),/,T47,'UNIT=(LUMEN/FT.SQ.)X100.',//)
      DO 111 K1=1,NY
      WRITE(6,616) Y(NY-K1+1), (NEPV((NY-K1+1),K2),K2=N1,N2)
  111 CONTINUE
C
      WRITE(6,620) (X(K3),K3=N1,N2)
C.....................................................................
  115 N1 = N2 + 1
      N2 = NX
  120 CONTINUE
C
  900 CONTINUE
C
      IF(LANE(2) .EQ. 0) C = 0
      MED = C + 1
      IF(C .EQ. 0) LANES(1) = LANE(1) + LANE(2)
      IF(C .NE. 0) LANES(1) = LANE(1)
      IF(C .NE. 0) LANES(2) = LANE(2)
      ISIZE = 0
      DO 2000 II=1,MED
         LOOP1 = LANES(II)
         IF(LOOP1 .EQ. 0) GO TO 2000
         DO 1000 I=1,LOOP1
C              GET AVERAGE FOR LEFT-RIGHT LANES
C
               EVAVG2(II) = EVAVG2(II) + EVAVG(I + ISIZE)
C
C              GET THE MAXIMUM VALUE
C
               IF(EVMAX(I+ISIZE) .GT. EVMAX2(II)) EVMAX2(II) =
     1          EVMAX(I + ISIZE)
C
C              GET THE MINIMUM VALUE
C
               IF(EVMIN(I+ISIZE) .LT. EVMIN2(II)) EVMIN2(II) =
     1          EVMIN(I + ISIZE)
 1000    CONTINUE
C
        IF(MDIV(II) .EQ. 0) GOTO 1100
          EVAVG2(II) = EVAVG2(II) + EVAVGS(II)
          COUNT(II) = COUNT(II) + 1.
          IF(EVMAXS(II) .GT. EVMAX2(II)) EVMAX2(II) = EVMAXS(II)
          IF(EVMINS(II) .LT. EVMIN2(II)) EVMIN2(II) = EVMINS(II)
```

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C
 1100 IF(MEDIV .EQ. 0) GOTO 1200
            EVAVG2(II) = EVAVG2(II) + EVAVGM/2.
            COUNT(II) = COUNT(II) + .5
            IF(EVMAXM .GT. EVMAX2(II)) EVMAX2(II) = EVMAXM
            IF(EVMINM .LT. EVMIN2(II)) EVMIN2(II) = EVMINM
C
 1200 IF((EVAVG2(II).EQ.0.0) .OR. (EVMIN2(II).EQ.0.0)) GO TO 4500
C
            EVAVG2(II) = EVAVG2(II)/(LANES(II) + COUNT(II))
C
C           GET THE MAX/AVG VALUE
C
            EVMXA2(II) = EVMAX2(II)/EVAVG2(II)
C
C           CALCULATE THE AVG/MIN VALUE
C
            EVAMN2(II) = EVAVG2(II)/EVMIN2(II)
C
C           CALCULATE THE MAX/MIN VALUE
C
            EVMXM2(II) = EVMAX2(II)/EVMIN2(II)
            ISIZE = LANE(I)
 2000 CONTINUE
C
C
C***************************************************************
C *** VERTICAL ILLUMINANCE SUMMARY CALCULATIONS
C
      IF(EPSLN.NE.0. .OR. ICURVE.NE.0) GO TO 2900
      ISIZE = 0
      DO 2500 II=1,MED
         LOOP1 = LANES(II)
         IF(LOOP1 .EQ. 0) GO TO 2500
         DO 2100 I=1,LOOP1
C              GET AVERAGE FOR LEFT-RIGHT LANES
C
               EPVAV2(II) = EPVAV2(II) + EPVAVG(I + ISIZE)
C
C              GET THE MAXIMUM VALUE
C
               IF(EPVMAX(I+ISIZE) .GT. EPVMX2(II)) EPVMX2(II) =
     1          EPVMAX(I + ISIZE)
C
C              GET THE MINIMUM VALUE
C
               IF(EPVMIN(I+ISIZE) .LT. EPVMN2(II)) EPVMN2(II) =
     1          EPVMIN(I + ISIZE)
 2100    CONTINUE
      IF(MDIV(II) .EQ. 0) GOTO 2200
         EPVAV2(II) = EPVAV2(II) + PVAVGS(II)
         COUNTV(II) = COUNTV(II) + 1.
         IF(PVMAXS(II) .GT. EPVMX2(II)) EPVMX2(II) = PVMAXS(II)
         IF(PVMINS(II) .LT. EPVMN2(II)) EPVMN2(II) = PVMINS(II)
C
 2200 IF(MEDIV .EQ. 0) GOTO 2300
         EPVAV2(II) = EPVAV2(II) + PVAVGM/2.
         COUNTV(II) = COUNTV(II) + .5
         IF(PVMAXM .GT. EVMAX2(II)) EVMAX2(II) = PVMAXM
         IF(PVMINM .LT. EVMIN2(II)) EVMIN2(II) = PVMINM
C
 2300 IF((EPVAV2(II).EQ.0.0) .OR. (EPVMN2(II).EQ.0.0)) GO TO 4550
C
            EPVAV2(II) = EPVAV2(II)/(LANES(II) + COUNTV(II))
C
C           GET THE MAX/AVG VALUE
C
            EPVMA2(II) = EPVMX2(II)/EPVAV2(II)
C
C           CALCULATE THE AVG/MIN VALUE
C
            EPVAM2(II) = EPVAV2(II)/EPVMN2(II)
C
C           CALCULATE THE MAX/MIN VALUE
C
            EPVMM2(II) = EPVMX2(II)/EPVMN2(II)
            ISIZE = LANE(I)
 2500 CONTINUE
C
C**************************************************************
C
C
C   LUMINATION CALCULATIONS - (REFLECTION)
C
 2900 IF(LUCODE.EQ.3 .OR. LUCODE.EQ.4) GO TO 5000
      JSIZE = 0
      DO 4000 JJ=1,MED
         LOOP2 = LANES(JJ)
         IF(LOOP2 .EQ. 0) GO TO 4000
         DO 3000 J=1,LOOP2
      WRITE(6,655) CHARS(1), CHARS(6), (EVAVG(K1),K1=1,K2)
      WRITE(6,655) CHARS(2), CHARS(6), (EVMAX(K1),K1=1,K2)
      WRITE(6,655) CHARS(3), CHARS(6), (EVMIN(K1),K1=1,K2)
      WRITE(6,655) CHARS(4), CHARS(1), (EVMAAV(K1),K1=1,K2)
      WRITE(6,655) CHARS(5), CHARS(3), (EVAVMI(K1),K1=1,K2)
      WRITE(6,655) CHARS(4), CHARS(3), (EVMAMI(K1),K1=1,K2)
      GOTO 5002
C
 5001 K2 = LANE(1)
      WRITE(6,731) ((LANO1,LANO2,K1),K1=1,K2)
  731 FORMAT(14X,'L.M.S.'/13X,'SHOULDER',6X,4(2A4,I2,5X)/)
      WRITE(6,655)
      WRITE(6,655) CHARS(1), CHARS(6), EVAVGS(1),(EVAVG(K1),K1=1,K2)
      WRITE(6,655) CHARS(2), CHARS(6), EVMAXS(1),(EVMAX(K1),K1=1,K2)
      WRITE(6,655) CHARS(3), CHARS(6), EVMINS(1),(EVMIN(K1),K1=1,K2)
      WRITE(6,655) CHARS(4), CHARS(1), EVMAVS(1),(EVMAAV(K1),K1=1,K2)
      WRITE(6,655) CHARS(5), CHARS(3), EVAVMS(1),(EVAVMI(K1),K1=1,K2)
      WRITE(6,655) CHARS(4), CHARS(3), EVMAMS(1),(EVMAMI(K1),K1=1,K2)
      IF(LANE(2) .EQ. 0) GOTO 5002
C
      WRITE(6,720)
      K2 = LANE(2) + LANE(1)
      K0 = LANE(1) + 1
      KK2 = K2-K0+1
      IF(KK2 .EQ. 1) WRITE(6,5010) ((LANO1,LANO2,K1),K1=K0,K2)
      IF(KK2 .EQ. 2) WRITE(6,5011) ((LANO1,LANO2,K1),K1=K0,K2)
      IF(KK2 .EQ. 3) WRITE(6,5012) ((LANO1,LANO2,K1),K1=K0,K2)
      IF(KK2 .EQ. 4) WRITE(6,5013) ((LANO1,LANO2,K1),K1=K0,K2)
 5010 FORMAT(14X,'MEDIAN',7X,2A4,I2,5X,'RHS. SHOULDER')
 5011 FORMAT(14X,'MEDIAN',7X,2(2A4,I2,5X),'RHS. SHOULDER')
 5012 FORMAT(14X,'MEDIAN',7X,3(2A4,I2,5X),'RHS. SHOULDER')
 5013 FORMAT(14X,'MEDIAN',7X,4(2A4,I2,5X),'RHS. SHOULDER')
      WRITE(6,655)
      WRITE(6,655) CHARS(1),CHARS(6),EVAVGM,(EVAVG(K1),K1=K0,K2),
     *             EVAVGS(2)
      WRITE(6,655) CHARS(2),CHARS(6),EVMAXM,(EVMAX(K1),K1=K0,K2),
     *             EVMAXS(2)
      WRITE(6,655) CHARS(3),CHARS(6),EVMINM,(EVMIN(K1),K1=K0,K2),
     *             EVMINS(2)
      WRITE(6,655) CHARS(4),CHARS(1),EVMAVM,(EVMAAV(K1),K1=K0,K2),
     *             EVMAVS(2)
      WRITE(6,655) CHARS(5),CHARS(3),EVAVMM,(EVAVMI(K1),K1=K0,K2),
     *             EVAVMS(2)
      WRITE(6,655) CHARS(4),CHARS(3),EVMAMM,(EVMAMI(K1),K1=K0,K2),
     *             EVMAMS(2)
 5002 WRITE(6,740)
  740 FORMAT(/' ROADWAY VALUES SUMMARY'/)
      IF(C .EQ. 0) GO TO 6000
      WRITE(6,636)
  636 FORMAT(T13,'LEFT SIDE',T28,'RIGHT SIDE'/ )
      WRITE(6,655) CHARS(1), CHARS(6), (EVAVG2(N),N=1,2)
      WRITE(6,655) CHARS(2), CHARS(6), (EVMAX2(N),N=1,2)
      WRITE(6,655) CHARS(3), CHARS(6), (EVMIN2(N),N=1,2)
      WRITE(6,655) CHARS(4), CHARS(1), (EVMXA2(N),N=1,2)
      WRITE(6,655) CHARS(5), CHARS(3), (EVAMN2(N),N=1,2)
      WRITE(6,655) CHARS(4), CHARS(3), (EVMXM2(N),N=1,2)
  655 FORMAT(T2,2A4,2X,8(F9.4,6X))
      GOTO 7000
 6000 WRITE(6,655) CHARS(1), CHARS(6), EVAVG2(1)
      WRITE(6,655) CHARS(2), CHARS(6), EVMAX2(1)
      WRITE(6,655) CHARS(3), CHARS(6), EVMIN2(1)
      WRITE(6,655) CHARS(4), CHARS(1), EVMXA2(1)
      WRITE(6,655) CHARS(5), CHARS(3), EVAMN2(1)
      WRITE(6,655) CHARS(4), CHARS(3), EVMXM2(1)
 7000 CONTINUE
C
C*****************************************************************
C *** VERTICAL ILLUMINANCE SUMMARY
C
      IF(EPSLN.NE.0. .OR. ICURVE.NE.0) GO TO 212
      WRITE(6,741)
      IF(UNIT .EQ. MM) WRITE(6,705)
      IF(UNIT .EQ. FF) WRITE(6,710)
  741 FORMAT('1',T36,'VERTICAL ILLUMINANCE CHARACTERIS',
     1      'TICS',/,T36,36('-'))
C       PRINT LANE RESULTS
      WRITE(6,720)
      IF(NEW) GOTO 6101
      WRITE(6,730) ((LANO1,LANO2,K1),K1=1,K2)
      WRITE(6,655)
      WRITE(6,655) CHARS(1), CHARS(6), (EPVAVG(K1),K1=1,K2)
      WRITE(6,655) CHARS(2), CHARS(6), (EPVMAX(K1),K1=1,K2)
      WRITE(6,655) CHARS(3), CHARS(6), (EPVMIN(K1),K1=1,K2)
      WRITE(6,655) CHARS(4), CHARS(1), (EPVMXA(K1),K1=1,K2)
      WRITE(6,655) CHARS(5), CHARS(3), (EPVAMN(K1),K1=1,K2)
      WRITE(6,655) CHARS(4), CHARS(3), (EPVMXM(K1),K1=1,K2)
C
      WRITE(6,740)
      IF(C .EQ. 0) GO TO 6100
```

```
C
C
C                GET AVERAGE FOR LEFT-RIGHT LANES
C
                 REAVG2(JJ) = REAVG2(JJ) + REFAVG(J + JSIZE)
                 RAVG2(JJ) = RAVG2(JJ) + RAVG(J + JSIZE)
C
C                GET THE MAXIMUM VALUE
C
                 IF(REFMAX(J+JSIZE) .GT. REMAX2(JJ))
     1            REMAX2(JJ) = REFMAX(J + JSIZE)
                 IF(RMAX(J+JSIZE) .GT. RMAX2(JJ))
     1            RMAX2(JJ) = RMAX(J + JSIZE)
C
C                GET THE MINIMUM VALUE
C
                 IF(REFMIN(J+JSIZE) .LT. REMIN2(JJ))
     1            REMIN2(JJ) = REFMIN(J + JSIZE)
                 IF(RMIN(J+JSIZE) .LT. RMIN2(JJ))
     1            RMIN2(JJ) = RMIN(J + JSIZE)
 3000       CONTINUE
C
      IF((REAVG2(JJ).EQ.0.0) .OR. (REMIN2(JJ).EQ.0.0)) GO TO 4600
      IF((RAVG2(JJ).EQ.0.0) .OR. (RMIN2(JJ).EQ.0.0)) GO TO 4400
            REAVG2(JJ) = REAVG2(JJ)/LANES(JJ)
            RAVG2(JJ) = RAVG2(JJ)/LANES(JJ)
C
C           GET THE MAX/AVG VALUE
C
            REMXA2(JJ) = REMAX2(JJ)/REAVG2(JJ)
            RMXA2(JJ) = RMAX2(JJ)/RAVG2(JJ)
C
C           CALCULATE THE AVG/MIN VALUE
C
            REAMN2(JJ) = REAVG2(JJ)/REMIN2(JJ)
            RAMN2(JJ) = RAVG2(JJ)/RMIN2(JJ)
C
C           CALCULATE THE MAX/MIN VALUE
C
            REMXM2(JJ) = REMAX2(JJ)/REMIN2(JJ)
            RMXM2(JJ) = RMAX2(JJ)/RMIN2(JJ)
      JSIZE = LANE(1)
 4000 CONTINUE
      GO TO 5000
 4400 WRITE(6,309)
  309 FORMAT(1X,'ERROR IN LUMINANCE LANE SUMMARY.')
      WRITE(6,310) JJ, RAVG2(JJ), JJ, RMIN2(JJ)
      GO TO 4700
 4500 WRITE(6,308)
  308 FORMAT(1X,'ERROR IN ILLUMINANCE SUMMARY.')
      WRITE(6,310) II, EVAVG2(II), II, EVMIN2(II)
  310 FORMAT(' DIVISION BY ZERO HAS OCCURRED-AVERAGE FOR LANE#',I1,
     1' IS ',F8.4,/T32,'MINIMUM FOR LANE#',I1,' IS ',F8.4)
      GO TO 4700
 4550 WRITE(6,312)
  312 FORMAT(1X,'ERROR IN VERTICAL ILLUMINANCE SUMMARY.')
      WRITE(6,310) II, EPVAV2(II), II, EPVMN2(II)
      GO TO 4700
 4600 WRITE(6,307)
  307 FORMAT(1X,'ERROR IN LUMINANCE ROADWAY SUMMARY.')
      WRITE(6,310) JJ, REAVG2(JJ), JJ, REMIN2(JJ)
 4700 WRITE(6,311)
  311 FORMAT(' PROGRAM TERMINATING DUE TO ERROR.')
      RETURN 1
C
C *** ILLUMINANCE CHARACTERISTICS
C
 5000 IF(EPSLN .EQ. 0) WRITE(6,700)
      IF(EPSLN .NE. 0) WRITE(6,701)
      IF(UNIT .EQ. MM) WRITE(6,705)
      IF(UNIT .EQ. FF) WRITE(6,710)
  700 FORMAT('1',T35,'HORIZONTAL ILLUMINANCE CHARACTER',
     1      'ISTICS',/,T35,38('-'))
  701 FORMAT('1',T36,'INCLINED ILLUMINANCE CHARACTERIS',
     1      'TICS',/,T36,36('-'))
  705 FORMAT(T46,'UNIT=LUX',//)
  710 FORMAT(T46,'UNIT=LUMEN/FT.SQ.',//)
C
C...PRINT LANE RESULTS
C
      WRITE(6,720)
  720 FORMAT(/' ROADWAY VALUES FOR:'/)
C
      IF(NEW) GOTO 5001
C
      K2 = LANE(1) + LANE(2)
      WRITE(6,730) ((LANO1,LANO2,K1),K1=1,K2)
  730 FORMAT(12X,8(2A4,I2,5X)/)
      WRITE(6,6-5)
      WRITE(6,636)
      WRITE(6,655) CHARS(1), CHARS(6), (EPVAV2(N),N=1,2)
      WRITE(6,655) CHARS(2), CHARS(6), (EPVMX2(N),N=1,2)
      WRITE(6,655) CHARS(3), CHARS(6), (EPVMN2(N),N=1,2)
      WRITE(6,655) CHARS(4), CHARS(1), (EPVMA2(N),N=1,2)
      WRITE(6,655) CHARS(5), CHARS(3), (EPVAM2(N),N=1,2)
      WRITE(6,655) CHARS(4), CHARS(3), (EPVMM2(N),N=1,2)
      GOTO 212
 6100 WRITE(6,655) CHARS(1), CHARS(6), EPVAV2(1)
      WRITE(6,655) CHARS(2), CHARS(6), EPVMX2(1)
      WRITE(6,655) CHARS(3), CHARS(6), EPVMN2(1)
      WRITE(6,655) CHARS(4), CHARS(1), EPVMA2(1)
      WRITE(6,655) CHARS(5), CHARS(3), EPVAM2(1)
      WRITE(6,655) CHARS(4), CHARS(3), EPVMM2(1)
C
 6101 K3 = LANE(1)
      WRITE(6,731) ((LANO1,LANO2,K1),K1=1,K3)
      WRITE(6,655)
      WRITE(6,655) CHARS(1),CHARS(6),PVAVGS(1),(EPVAVG(K1),K1=1,K3)
      WRITE(6,655) CHARS(2),CHARS(6),PVMAXS(1),(EPVMAX(K1),K1=1,K3)
      WRITE(6,655) CHARS(3),CHARS(6),PVMINS(1),(EPVMIN(K1),K1=1,K3)
      WRITE(6,655) CHARS(4),CHARS(1),PVMAVS(1),(EPVMXA(K1),K1=1,K3)
      WRITE(6,655) CHARS(5),CHARS(3),PVAVMS(1),(EPVAMN(K1),K1=1,K3)
      WRITE(6,655) CHARS(4),CHARS(3),PVMAMS(1),(EPVMXM(K1),K1=1,K3)
C
      IF(LANE(2) .EQ. 0) GOTO 6150
      WRITE(6,720)
      IF(KK2 .EQ. 1) WRITE(6,5010) ((LANO1,LANO2,K1),K1=K0,K2)
      IF(KK2 .EQ. 2) WRITE(6,5011) ((LANO1,LANO2,K1),K1=K0,K2)
      IF(KK2 .EQ. 3) WRITE(6,5012) ((LANO1,LANO2,K1),K1=K0,K2)
      IF(KK2 .EQ. 4) WRITE(6,5013) ((LANO1,LANO2,K1),K1=K0,K2)
      WRITE(6,655)
      WRITE(6,655) CHARS(1),CHARS(6),PVAVGM,(EPVAVG(K1),K1=K0,K2),
     *             PVAVGS(2)
      WRITE(6,655) CHARS(2),CHARS(6),PVMAXM,(EPVMAX(K1),K1=K0,K2),
     *             PVMAXS(2)
      WRITE(6,655) CHARS(3),CHARS(6),PVMINM,(EPVMIN(K1),K1=K0,K2),
     *             PVMINS(2)
      WRITE(6,655) CHARS(4),CHARS(1),PVMAVM,(EPVMXA(K1),K1=K0,K2),
     *             PVMAVS(2)
      WRITE(6,655) CHARS(5),CHARS(3),PVAVMM,(EPVAMN(K1),K1=K0,K2),
     *             PVAVMS(2)
      WRITE(6,655) CHARS(4),CHARS(3),PVMAMM,(EPVMXM(K1),K1=K0,K2),
     *             PVMAMS(2)
C
 6150 WRITE(6,740)
      IF(L .EQ. 0) GO TO 6200
      WRITE(6,636)
      WRITE(6,655) CHARS(1), CHARS(6), (EPVAV2(N),N=1,2)
      WRITE(6,655) CHARS(2), CHARS(6), (EPVMX2(N),N=1,2)
      WRITE(6,655) CHARS(3), CHARS(6), (EPVMN2(N),N=1,2)
      WRITE(6,655) CHARS(4), CHARS(1), (EPVMA2(N),N=1,2)
      WRITE(6,655) CHARS(5), CHARS(3), (EPVAM2(N),N=1,2)
      WRITE(6,655) CHARS(4), CHARS(3), (EPVMM2(N),N=1,2)
      GOTO 212
 6200 WRITE(6,655) CHARS(1), CHARS(6), EPVAV2(1)
      WRITE(6,655) CHARS(2), CHARS(6), EPVMX2(1)
      WRITE(6,655) CHARS(3), CHARS(6), EPVMN2(1)
      WRITE(6,655) CHARS(4), CHARS(1), EPVMA2(1)
      WRITE(6,655) CHARS(5), CHARS(3), EPVAM2(1)
      WRITE(6,655) CHARS(4), CHARS(3), EPVMM2(1)
C.....................................................................
C
C
  212 IF(LUCODE .GT. 1) GO TO 902
C
C *** OUTPUT LUMINANCE TABLES
      REWIND 10
C ****
      DO 210 K1=1,NC
      N1 = 1
      N2 = NXMED
      READ(10) REF
      DO 210 K2=1,2
      IF(LANE(K2) .EQ. 0) GO TO 210
      IF(K2 .EQ. 1) GO TO 215
      N1 = N2 + 1
      N2 = NX
C
  215 IF(WMED .EQ. 0.) GO TO 220
C *** OUTPUT LOGIC FOLLOWS FORMAT STATEMENT 625
      IF((K1.LE.LANE(1) .AND. K2.EQ.1) .OR.
     1   (K1.GT.LANE(1) .AND. K2.EQ.2)) GO TO 220
      GO TO 210
C
  220 WRITE(6,625)
  625 FORMAT('1','N.B. WHEN THERE IS MEDIAN, LUMINANCE WILL BE GIVEN ',
     1           'ONLY FOR THE ROADWAY WHERE THE DRIVER BELONGS',/ )
```

```
C ****
      WRITE(6,628) LR(K2), K1
      IF(UNIT .EQ. MM) WRITE(6,630)
      IF(UNIT .EQ. FF) WRITE(6,6630)
  628 FORMAT(T30,'LUMINANCE FOR ',A1,'.H.S. ROADWAY WHEN DRIVING ALONG',
     1       ' LANE',I2, /,T30,54('-'))
  630 FORMAT(T50,'UNIT=CD/M.SQ.',/)
 6630 FORMAT(T52,'UNIT=FT.L.',/)
C
C...................................................................
      IF(EPSLN .EQ. 0) GO TO 229
      DO 225 K3=1,NY
      WRITE(6,614) Y(NY-K3+1), YSLOP(NY-K3+1), (REF((NY-K3+1),K4),
     1              K4=N1,N2)
  614 FORMAT(1X,F6.1,2X,F6.1,' |',19F6.2,/,17X,19F6.2,/)
  225 CONTINUE
      WRITE(6,617) (X(K5),K5=N1,N2)
      GO TO 210
  229 CONTINUE
C...................................................................
      DO 230 K3=1,NY
      WRITE(6,615) Y(NY-K3+1), (REF((NY-K3+1),K4),K4=N1,N2)
  615 FORMAT(1X,F7.2,' | ',19F6.2,/,11X,19F6.2,/)
  230 CONTINUE
C
      WRITE(6,620) (X(K5),K5=N1,N2)
      IF(ICURVE .NE. 0) WRITE(6,303)
C
  210 CONTINUE
C
  902 IF(LUCODE .GT. 2) GO TO 9000
C
C *** LUMINANCE CHARACTERISTICS
C
  240 WRITE(6,645)
      IF(UNIT .EQ. MM) WRITE(6,650)
      IF(UNIT .EQ. FF) WRITE(6,6650)
  645 FORMAT('1', T46,'LUMINANCE CHARACTERISTICS',/,T46,25('-'))
  650 FORMAT(T51,'UNIT=CD/M.SQ.',// )
 6650 FORMAT(T51,'UNIT=FT.L.',// )
      WRITE(6,720)
      K2 = LANE(1) + LANE(2)
      WRITE(6,730) ((LANO1,LANO2,K1),K1=1,K2)
      WRITE(6,655)
      WRITE(6,655) CHARS(1), CHARS(6), (REFAVG(K1),K1=1,K2)
      WRITE(6,655) CHARS(2), CHARS(6), (REFMAX(K1),K1=1,K2)
      WRITE(6,655) CHARS(3), CHARS(6), (REFMIN(K1),K1=1,K2)
      WRITE(6,655) CHARS(4), CHARS(1), (REMAAV(K1),K1=1,K2)
      WRITE(6,655) CHARS(5), CHARS(3), (REAVMI(K1),K1=1,K2)
      WRITE(6,655) CHARS(4), CHARS(3), (REMAMI(K1),K1=1,K2)
C
      WRITE(6,740)
      IF(C .EQ. 0) GO TO 8000
      WRITE(6,636)
      WRITE(6,655) CHARS(1), CHARS(6), (REAVG2(N),N=1,2)
      WRITE(6,655) CHARS(2), CHARS(6), (REMAX2(N),N=1,2)
      WRITE(6,655) CHARS(3), CHARS(6), (REMIN2(N),N=1,2)
      WRITE(6,655) CHARS(4), CHARS(1), (REMXA2(N),N=1,2)
      WRITE(6,655) CHARS(5), CHARS(3), (REAMN2(N),N=1,2)
      WRITE(6,655) CHARS(4), CHARS(3), (REMXM2(N),N=1,2)
      GOTO 9000
 8000 WRITE(6,655) CHARS(1), CHARS(6), REAVG2(1)
      WRITE(6,655) CHARS(2), CHARS(6), REMAX2(1)
      WRITE(6,655) CHARS(3), CHARS(6), REMIN2(1)
      WRITE(6,655) CHARS(4), CHARS(1), REMXA2(1)
      WRITE(6,655) CHARS(5), CHARS(3), REAMN2(1)
      WRITE(6,655) CHARS(4), CHARS(3), REMXM2(1)
 9000 CONTINUE
C
C...................................................................
C
      WRITE(6,301)
  301 FORMAT(/,' LANE VALUES FOR DRIVER IN:',/)
      WRITE(6,730) ((LANO1,LANO2,K1),K1=1,K2)
      WRITE(6,655)
      WRITE(6,655) CHARS(1), CHARS(6), (RAVG(K1),K1=1,K2)
      WRITE(6,655) CHARS(2), CHARS(6), (RMAX(K1),K1=1,K2)
      WRITE(6,655) CHARS(3), CHARS(6), (RMIN(K1),K1=1,K2)
      WRITE(6,655) CHARS(4), CHARS(1), (RMAAV(K1),K1=1,K2)
      WRITE(6,655) CHARS(5), CHARS(3), (RAVMI(K1),K1=1,K2)
      WRITE(6,655) CHARS(4), CHARS(3), (RMAMI(K1),K1=1,K2)
C
      WRITE(6,745)
  745 FORMAT(/,' LANE VALUES SUMMARY'/)
      IF(C .EQ. 0) GO TO 302
      WRITE(6,636)
      WRITE(6,655) CHARS(1), CHARS(6), (RAVG2(N),N=1,2)
      WRITE(6,655) CHARS(2), CHARS(6), (RMAX2(N),N=1,2)
      WRITE(6,655) CHARS(3), CHARS(6), (RMIN2(N),N=1,2)
      WRITE(6,655) CHARS(4), CHARS(1), (RMXA2(N),N=1,2)
      WRITE(6,655) CHARS(5), CHARS(3), (RAMN2(N),N=1,2)
      WRITE(6,655) CHARS(4), CHARS(3), (RMXM2(N),N=1,2)
      GO TO 304
  302 WRITE(6,655) CHARS(1), CHARS(6), RAVG2(1)
      WRITE(6,655) CHARS(2), CHARS(6), RMAX2(1)
      WRITE(6,655) CHARS(3), CHARS(6), RMIN2(1)
      WRITE(6,655) CHARS(4), CHARS(1), RMXA2(1)
      WRITE(6,655) CHARS(5), CHARS(3), RAMN2(1)
      WRITE(6,655) CHARS(4), CHARS(3), RMXM2(1)
  304 CONTINUE
C
C.........................................................................
C
C *** OUTPUT DISABILITY VEILING BRIGHTNESS
C
      DO 800 K=1,8
      SUMAK(K) = 0.
      WRSAVG(K) = -99999.
  800 DVBMAX(K) = -99999.
C
      IF(LUCODE.EQ.2 .OR. LUCODE.EQ.4) GO TO 901
C
C.........................................................................
      IF(EPSLN .EQ. 0.) GO TO 830
      WRITE(6,803)
      IF(UNIT .EQ. MM) WRITE(6,805)
      IF(UNIT .EQ. FF) WRITE(6,806)
      WRITE(6,808)
  803 FORMAT('1',T44,'DISABILITY VEILING BRIGHTNESS',/,T44,29('-'))
  805 FORMAT(T52,'UNIT=CD/M.SQ.')
  806 FORMAT(T53,'UNIT=FT.L.')
  808 FORMAT(/,' N.B. DVB GIVEN ARE FOR DRIVER POSITION (X,Y-HOR)',
     1       ' AND (X,Y-SLOP) ')
      GO TO 901
C.........................................................................
  830 WRITE(6,632)
      IF(UNIT .EQ. MM) WRITE(6,635)
      IF(UNIT .EQ. FF) WRITE(6,6635)
      WRITE(6,6638)
  632 FORMAT('1',T44,'DISABILITY VEILING BRIGHTNESS',/,T44,29('-'))
  635 FORMAT(T52,'UNIT=CD/M.SQ.')
 6635 FORMAT(T53,'UNIT=FT.L.')
 6638 FORMAT(/,' N.B. DVB GIVEN ARE FOR DRIVER POSITION (X,Y) ')
C
  901 CONTINUE
C
      NC1 = 1
      NC4 = NC
      IF(NC .GT. 4) NC4 = 4
      DO 637 M=1,2
      IF(LANE(M) .EQ. 0) GO TO 637
      IF(M .EQ. 1) GO TO 906
      IF(NC.LE.4 .AND. EPSLN.EQ.0.0) GO TO 637
      NC1 = 5
      NC4 = NC
C
  906 IF(LUCODE.EQ.2 .OR. LUCODE.EQ.4) GO TO 903
C
      IF(EPSLN .NE. 0.) GO TO 642
  638 WRITE(6,639) ((LANO1,LANO2,K1),K1=NC1,NC4)
  639 FORMAT(//,T10,4(2A4,I2,20X))
      WRITE(6,6399) ((XYDVB1,XYDVB2,XYDVB3),K1=NC1,NC4)
 6399 FORMAT(4(3X,A4,2X,A4,10X,A4,4X))
C
C.........................................................................
      GO TO 903
C
  642 CONTINUE
      IF(M .EQ. 1) NC4 = LANE(1)
      IF(M .EQ. 2) NC1 = LANE(1) + 1
      WRITE(6,660) (XYDVB3,K1=NC1,NC4)
  660 FORMAT(//,T26,4(A4,10X))
      WRITE(6,661) ((LANO1,LANO2,K1),K1=NC1,NC4)
  661 FORMAT(T23,4(2A4,I1,5X))
      WRITE(6,662) ((XYDVB4,XLC(1,K)),K=NC1,NC4)
  662 FORMAT(T4,'Y-HOR    Y-SLOP',T22,4(A4,F6.2,4X))
      LEN = 4*LANE(M)
      WRITE(6,663) (DASH,K1=1,LEN)
  663 FORMAT(T19,'+',16A4)
C.........................................................................
C
  903 CONTINUE
C
      DO 300 K1=1,NY
C
      IF(LUCODE.EQ.2 .OR. LUCODE.EQ.4) GO TO 904
      IF(EPSLN .NE. 0.) GO TO 646
C
```

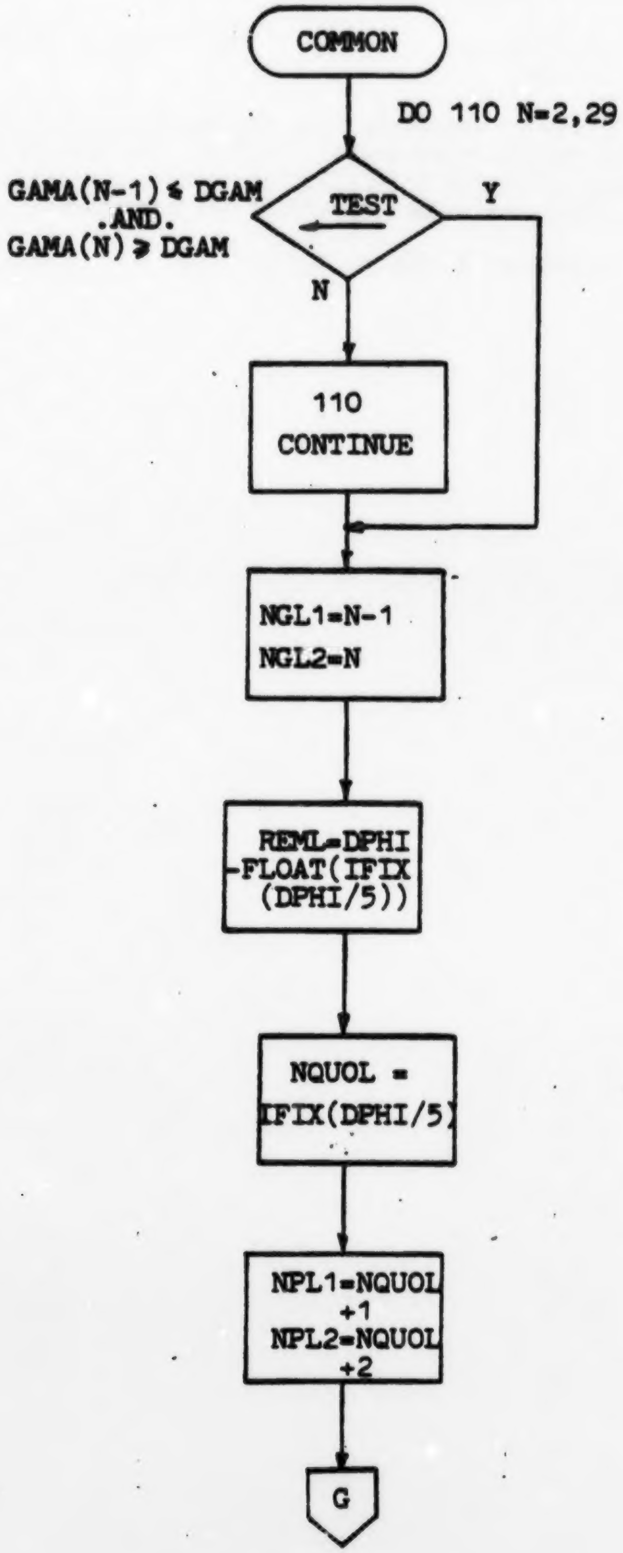
```
      IF(K1 .EQ. 1) WRITE(6,640) (XLC(1,K),YLC(NY-K1+1,K),
     1   DVB(NY-K1+1,K),K=NC1,NC4)
      IF(K1 .NE. 1) WRITE(6,641) (YLC(NY-K1+1,K),DVB(NY-K1+1,K),
     1   K=NC1,NC4)
  640 FORMAT(4(2(F7.2,3X),F7.3,3X))
  641 FORMAT(4(10X,F7.2,3X,F7.3,3X))
C.......................................................................
      GO TO 904
  646 CONTINUE
C        YLC1 IS DRIVER ORDINATE ON HORIZONTAL WHEN THERE IS A SLOPE
      YLC1(NY-K1+1,NC1) = Y(NY-K1+1) - FM90*COS(EPSLN)
      IF(M.EQ.1 .AND. .NOT.REV) YLC1(NY-K1+1,NC1) = Y(K1) + FM90
     1      *COS(EPSLN)
C        YLCSLP IS DRIVER ORDINATE ON THE SLOPING ROAD SURFACE
      YLCSLP(NY-K1+1,NC1) = YSLOP(NY-K1+1) - FM90
      IF(M.EQ.1 .AND. .NOT.REV) YLCSLP(NY-K1+1,NC1) = YSLOP(K1) + FM90
      WRITE(6,648) YLC1(NY-K1+1,NC1), YLCSLP(NY-K1+1,NC1),
     1   (DVB(NY-K1+1,K),K=NC1,NC4)
  648 FORMAT(1X,F7.2,2X,F7.2,1X,'I',4(3X,F7.3,4X))
C
C.....................................................................
C
      IF(ICURVE .NE. 0) WRITE(6,303)
  904 CONTINUE
C
C
C           ACCUMULATE DVB AND FIND MAX. VALUE ON EACH LANE
C
      DO 820 K=NC1,NC4
      DUM = DVB(NY-K1+1,K)
      IF(DVBMAX(K) .GE. DUM) GO TO 810
      DVBMAX(K) = DUM
      LOC(K) = NY - K1 + 1
  810 SUMAR(K) = SUMAR(K) + DUM
  820 CONTINUE
C
  300 CONTINUE
  637 CONTINUE
C
C
C         FIND AVERAGE AND THE HIGHEST AVERAGE AROUND THE MAX. DVB
C
      PRINT = .TRUE.
      YSTRIP = DISTP/FLOAT(KDIV)
      DUM = 10.
      IF(UNIT .EQ. FF) DUM = 33.
      IF(YSTRIP*2. .GT. DUM) PRINT = .FALSE.
C     IF ( .NOT.PRINT ) GO TO 859
      NN = (DUM-1.)/YSTRIP + 1
      DO 860 K=1,NC
      DVBAVG(K) = SUMAR(K)/NY
      N1 = LOC(K) - NN - 1
      IF(N1 .LT. 0) N1 = 0
      N2 = LOC(K) + NN
      IF(N2 .GT. NY) N2 = NY
      K2 = N2 - N1 - NN
      IF(K2 .LT. 1) K2 = 1
      JJ = NN
      IF(JJ .GT. NY) JJ = NY
      DO 850 N=1,K2
      SUM = 0.
      DO 840 L=1,JJ
  840 SUM = SUM + DVB(N1+L,K)
      AVG = SUM/JJ
      IF(WKSAVG(K) .LT. AVG) WKSAVG(K) = AVG
  850 N1 = N1 + 1
      DMLAV(K) = WKSAVG(K)/RAVG(K)
  859 DVBLAV(K) = DVBAVG(K)/RAVG(K)
  860 CONTINUE
C
      WRITE(6,750)
  750 FORMAT (1H1,T40,'INDIVIDUAL  DVB  RESULTS'/T40,24('-')/)
      WRITE(6,751) ((LANO1,LANO2,K1),K1=1,NC)
  751 FORMAT(T27,8(2A4,I2,3X))
      WRITE(6,752)
      WRITE(6,752) XYDVB3, CHARS(1), CHARS(6), (DVBAVG(K),K=1,NC)
  752 FORMAT(T2,3A4,T22,8(F8.4,5X))
      WRITE(6,752) XYDVB3, CHARS(2), CHARS(6), (DVBMAX(K),K=1,NC)
      IF(PRINT) WRITE(6,754) XYDVB3, CHARS(2), CHARS(1),
     1                         DVB3, (WKSAVG(K),K=1,NC)
      WRITE(6,754) DVB1, CHARS(1), DVB2, LANO1, (RAVG(K),K=1,NC)
      WRITE(6,752)
      WRITE(6,754) XYDVB3, CHARS(5), DVB1, CHARS(1), (DVBLAV(K),K=1,NC)
  754 FORMAT(T2,4A4,T22,8(F8.4,5X))
      IF(PRINT) WRITE(6,756) XYDVB3, CHARS(2), CHARS(5), DVB1,
     1                         CHARS(1),(DMLAV(K),K=1,NC)
  756 FORMAT(T2,5A4,T22,8(F8.4,5X))
C
      IF(PRINT) WRITE(6,758)
  758 FORMAT(///1X,'* DVB MAX AVG - IS THE MAXIMUM VALUE OF THE ',
     1 'MOVING AVERAGE WITHIN AN INTERVAL OF 33 FEET OR 10 METRES.')
C
  905 CONTINUE
C
      RETURN
      END
```

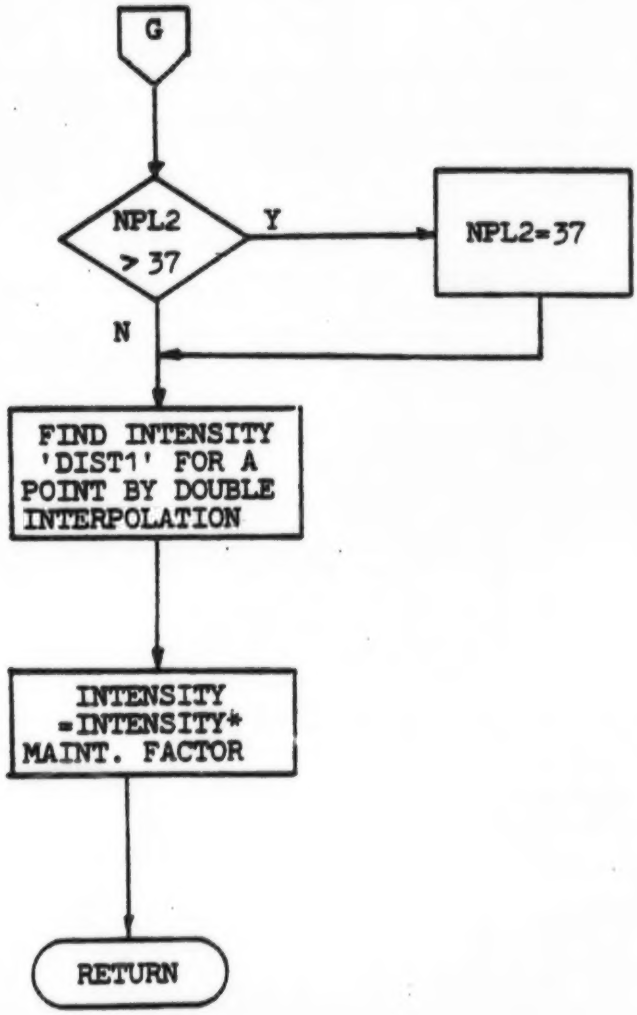
D.6/ GAMPHI Subroutine Flowchart and Program Listing

This routine finds the luminous intensity of the luminaire towards each grid point on the roadway.

It calculates this luminous intensity from the manufacturer's intensity tables by double interpolation of angles γ and ϕ. The interpolation is based on the Lagrange parabolic interpolation technique utilising three sets of reference points for establishment of the curvature.

FLOWCHART & PROGRAM DESCRIPTION


COMMON
DO 110 N=2,29
GAMA(N-1) ≤ DGAM
.AND.
GAMA(N) ≥ DGAM
TEST
Y
N
110
CONTINUE
NGL1=N-1
NGL2=N
REML=DPHI
-FLOAT(IFIX
(DPHI/5))
NQUOL =
IFIX(DPHI/5)
NPL1=NQUOL
+1
NPL2=NQUOL
+2
G

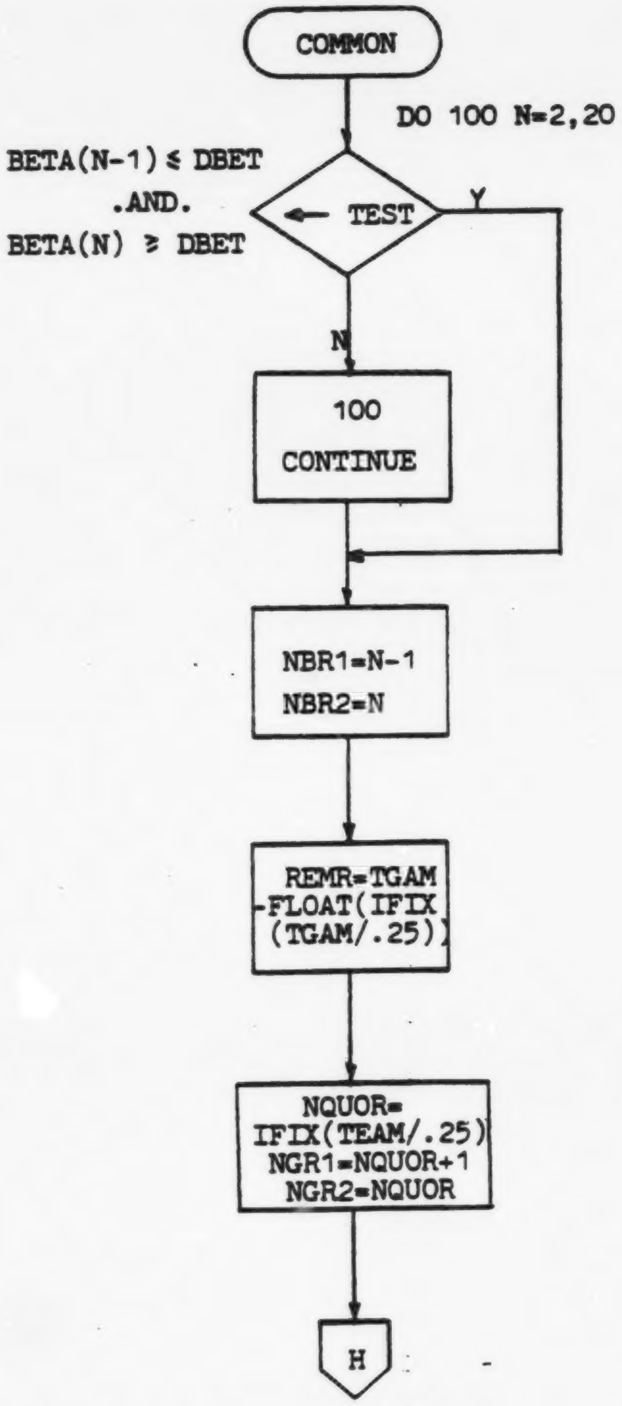

G
NPL2 > 37
Y
N
NPL2=37
FIND INTENSITY 'DIST1' FOR A POINT BY DOUBLE INTERPOLATION
INTENSITY =INTENSITY* MAINT. FACTOR
RETURN

```
      SUBROUTINE GAMPHI(DGAM.DPHI.DIST7.K4)
C
      COMMON /ONE/   DISTP.      DVBANG(3).FMAIN(4). HT(4).      KDIV.
     1               LANE(2).    LUSTAT(4).MDIV(2).  NLR(4).     NLUA.
     2               NSTRIP.     OFFSET(4).PATERN.   PAVTYE.     QO .
     3               RDWAY(2).   REV.      TYPE(4).  UNIT.       USTAT(4).
     4               WMED.       LUCODE.   MANUF
C
      COMMON /THREE/BETA(20).              DIST(37.29).          DVB(91.8).
     1               EP(91.42).            GAMA(29).             REF(91.42).
     2               REFLEC(20.49).        EVAVG(8).             EVMAX(8).
     3               EVMIN(8).             EVAVMI(8).            EVMAAV(8).
     4               EVMAMI(8).            REFAVG(8).            REFMAX(8).
     5               REFMIN(8).            REAVMI(8).            REMAAV(8).
     6               REMAMI(8).            NEP(91.42)
C
      COMMON /CONST/DETORA. PI. HAPPI. PI10. HYDRIV. PH90. ANGLIN.
     1              TYPNO. NMANU. NOPN
C
      DIMENSION  A(3.3), B(3), F(3)
C
      DO 110 N=2.29
      IF(GAMA(N-1).LE.DGAM .AND. GAMA(N).GE.DGAM) GO TO 120
  110 CONTINUE
  120 NGL1 = N - 1
      NGL2 = N
C
      REML = AMOD(DPHI.5.)
      QUOL = DPHI/5. + 0.001
      NQUOL = IFIX(QUOL)
      NPL1 = NQUOL + 1
      NPL2 = NQUOL + 2
      IF(NPL2 .GT. 37) NPL2 = 37
C
C        LAGRANGE INTERPOLATION METHOD OF SECOND DEGREE
C        AS PROPOSED IN THE CIE REPORT TYPE2
C
      AVG = (GAMA(NGL1)+GAMA(NGL2))/2.
      IF(NGL1 .EQ. 1) GO TO 200
      IF(NGL2 .EQ. 29) GO TO 150
      IF(DGAM .GE. AVG) GO TO 200
  150 NGL1 = NGL1 - 1
C
  200 IF(NPL2 .EQ. 37) GO TO 250
      IF(NPL1 .EQ. 1) GO TO 300
      IF(REML .GE. 2.5) GO TO 300
  250 NPL1 = NPL1 - 1
C
  300 DO 400 I=1.3
      II = NPL1 + I - 1
      DO 400 J=1.3
      JJ = NGL1 + J - 1
  400 A(I.J) = DIST(II.JJ)
C
C
      DO 550 J=1.3
      FACT = 1.
      JJ = NGL1 + J - 1
      GG = GAMA(JJ)
      DO 500 L=1.3
      IF(J .EQ. L) GO TO 500
      G2 = GAMA(NGL1+L-1)
      FACT = FACT*(DGAM-G2)/(GG-G2)
  500 CONTINUE
  550 F(J) = FACT
C
      DO 600 I=1.3
      SUM = 0.0
      DO 580 J=1.3
  580 SUM = SUM + A(I.J)*F(J)
  600 B(I) = SUM
C
      SUM = 0.
      DO 700 I=1.3
      FACT = B(I)
      PP = (NPL1+I-2)*5.0
      DO 650 J=1.3
      IF(I .EQ. J) GO TO 650
      P2 = (NPL1+J-2)*5.0
      FACT = FACT*(DPHI-P2)/(PP-P2)
  650 CONTINUE
  700 SUM = SUM + FACT
      DIST7 = SUM*FMAIN(K4)
      RETURN
      END
```

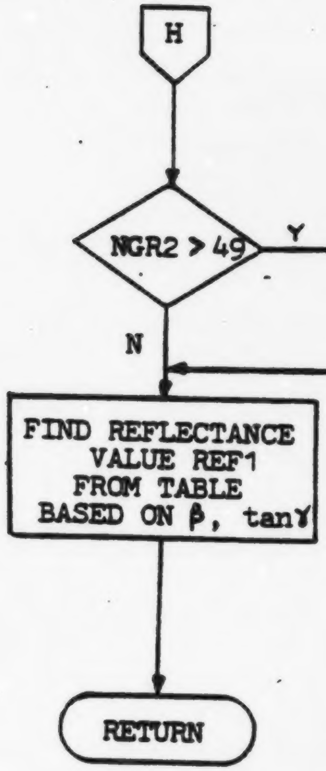
D.7/ BETGAM Subroutine Flowchart and Program Listing

This routine determines the reduced luminance coefficent value for each grid point on the roadway by interpolating β and γ angle values of road surface reflectance tables. The interpolation is based on the Lagrange parabolic interpolation method (three values).

FLOWCHART & PROGRAM DESCRIPTION


COMMON
DO 100 N=2,20
BETA(N-1) ≤ DBET
.AND.
BETA(N) ≥ DBET
TEST
Y
N
100
CONTINUE
NBR1=N-1
NBR2=N
REMR=TGAM
-FLOAT(IFIX
(TGAM/.25))
NQUOR=
IFIX(TEAM/.25)
NGR1=NQUOR+1
NGR2=NQUOR
H

38

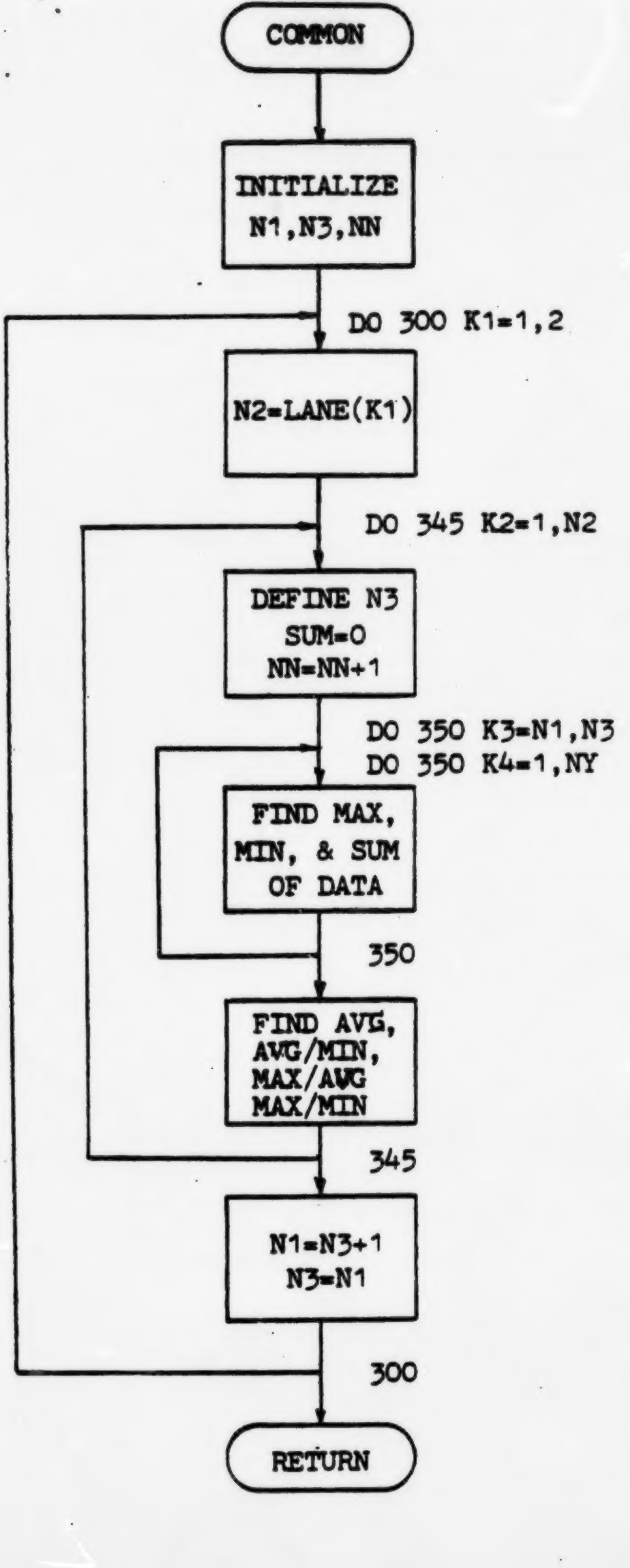

H
NGR2 > 49
Y
NGR2=49
N
FIND REFLECTANCE VALUE REF1 FROM TABLE BASED ON β, tanγ
RETURN

```
      SUBROUTINE BETGAM(BET.TGAM.REF7.EPI.ZL)
C
C     THIS ROUTINE PICKS REFLECTANCE VALUES FROM R-TABLE AND
C     CALCULATES REFLECTANCE
C
C     ******************************************************************
C
C
      COMMON /ONE/   DISTP.      DVBANG(3).FMAIN(4). HT(4).      KDIV.
     1               LANE(2).    LUSTAT(4).MDIV(2).  NLR(4).     NLUA.
     2               NSTHIP.     OFFSET(4).PATERN.   PAVTYE.     QO.
     3               HDWAY(2).   REV.      TYPE(4).  UNIT.       USTAT(4).
     4               WMED.       LUCODE.   MANUF
C
      COMMON /THREE/BETA(20).              DIST(37.29).          DVB(91.8).
     1              EP(91.42).             GAMA(29).             REF(91.42).
     2              REFLEC(20.49).         EVAVG(8).             EVMAX(8).
     3              EVMIN(8).              EVAVMI(8).            EVMAAV(8).
     4              EVMAMI(8).             REFAVG(8).            REFMAX(8).
     5              REFMIN(8).             REAVMI(8).            REMAAV(8).
     6              REMAMI(8).             NEP(91.42)
      COMMON /CONST/DETORA. PI. HAFPI. PI10. HTDRIV. FM90. ANGLIM.
     1         TYPNO. NMANU. NOPN
      DIMENSION A(3.3). B(3). F(3)
C
C        LAGRANGE INTERPOLATION FORMULA OF SECOND DEGREE
C        TYPE 1 AS IN CIE REPORT
C
      DBET = BET/DETORA
      DO 100 N=2.20
      IF(BETA(N-1).LE.DBET .AND. BETA(N).GE.DBET) GO TO 105
  100 CONTINUE
  105 NBR1 = N - 1
      NBR2 = N
C
      IF( TGAM .LE. 2.0 ) QUOR = TGAM/0.25
      IF( TGAM .GT. 2.0 ) QUOR = 8. + (TGAM - 2.0)/0.5
C
      NQUOR = IFIX(QUOR)
      NGR1 = NQUOR + 1
      NGR2 = NQUOR + 2
      IF(NGR2 .GT. 29) NGR2 = 29
      IF(NBR2 .EQ. 20) NBR1 = NBR1-1
      IF(NGR2 .EQ. 29) NGR1 = NGR1-1
C
      DO 300 I=1.3
      II = NBR1 + I - 1
      DO 300 J=1.3
      JJ = NGR1 + J - 1
  300 A(I.J) = REFLEC(II.JJ)
C
      DO 400 I=1.3
      FACT = 1.
      BB = BETA(NBR1+I-1)
      DO 350 J=1.3
      IF(I .EQ. J) GO TO 350
      B2 = BETA(NBR1+J-1)
      FACT = FACT*(DBET-B2)/(BB-B2)
  350 CONTINUE
  400 F(I) = FACT
C
      DO 480 I=1.3
      SUM = 0.
      DO 450 J=1.3
  450 SUM = SUM + A(J.I)*F(J)
  480 B(I) = SUM
C
      SUM = 0.
      DO 600 I=1.3
      FACT = B(I)
      IF(NGR1 .LE. 9) TT = (NGR1+I-2)*0.25
      IF(NGR1 .GT. 9) TT = 2.0 + ((NGR1-9)+I-2)*0.50
      IF(NGR1.EQ.9 .AND. ABS(TT-2.50).LT.0.01) TT = 3.00
      IF(ABS(TT-2.25) .LT. 0.01) TT = 2.50
      DO 550 J=1.3
      IF(I .EQ. J) GO TO 550
      IF(NGR1 .LE. 9) T2 = (NGR1+J-2)*0.25
      IF(NGR1 .GT. 9) T2 = 2.0 + ((NGR1-9)+J-2)*0.50
      IF(NGR1.EQ.9 .AND. ABS(T2-2.50).LT.0.01) T2 = 3.00
      IF(ABS(T2-2.25) .LT. 0.01) T2 = 2.50
      FACT = FACT*(TGAM-T2)/(TT-T2)
  550 CONTINUE
  600 SUM = SUM + FACT
C
      REF7 = SUM*QO*EPI/(ZL*ZL)
      RETURN
      END
```

D.8/ AVMAMI Subroutine Flowchart and Program Listing

This routine calculates the maximum, minimum, and the average illuminance and luminance values for each lane and roadway. Also, it calculates the uniformity ratios (i.e., AVG/MAX, MAX/MIN, MAX/AVG) of illuminance and luminance for each lane and each roadway.

FLOWCHART & PROGRAM DESCRIPTION


COMMON
INITIALIZE N1,N3,NN
DO 300 K1=1,2
N2=LANE(K1)
DO 345 K2=1,N2
DEFINE N3
SUM=0
NN=NN+1
DO 350 K3=N1,N3
DO 350 K4=1,NY
FIND MAX, MIN, & SUM OF DATA
350
FIND AVG, AVG/MIN, MAX/AVG MAX/MIN
345
N1=N3+1
N3=N1
300
RETURN

```
      SUBROUTINE AVMAMI(DATAS.AVG.XMAX.XMIN.AVGMIN.MAXAVG.MAXMIN.NCHK)
C
C     THIS ROUTINE FINDS ILLUMINANCE.LUMINANCE CHARACTERISTICS
C
C     ****************************************************************
C
      COMMON /ONE/   DISTP.      DVBANG(3).FMAIN(4).  HT(4).     KDIV.
     1               LANE(2).    LUSTAT(4).MDIV(2).   NLR(4).    NLUA.
     2               NSTRIP.     OFFSET(4).PATERN.    PAVTYE.    QO .
     3               RDWAY(2).   REV.       TYPE(4).  UNIT.      USTAT(4).
     4               WMED.       LUCODE.    MANUF
C
      COMMON /TWO/   STAT(4).    X(42).     XLC(91.8).  XLU(26.4).XSTRIP(2).
     1               PAVE(4).    Y(91).     YLC(91.8).  YLU(26.4).ZLU(26.4).
     2               NC.         NLU(4). NX.            NXMED.    NY
      COMMON /CONST/DETORA. PI. HAFPI. PI10. HTDRIV. FM90. ANGLIM.
     1               TYPNO. NMANU. NOPN
C
      REAL DATAS(91.42). AVG(8). XMAX(8). XMIN(8). AVGMIN(8).
     1     MAXAVG(8). MAXMIN(8)
C
      N1 = MDIV(1) + 1
      N3 = N1
      NN = 0
C
C *** DO LOOP BASED ON MAX. NO. OF ROADWAY.I.E. 2
      DO 300 K1=1.2
      IF(LANE(K1) .EQ. 0) GO TO 300
      N2 = LANE(K1)
C
C *** DO LOOP BASED ON MAX. NO. OF LANES IN EACH ROADWAY
      DO 345 K2=1.N2
      N3 = N3 + NSTRIP
      IF(NCHK .EQ. 1) GO TO 220
      READ(10) DATAS
      IF(NCHK .EQ. 0) GO TO 200
      NINIT = MDIV(1)
      IF(K1 .EQ. 2) NINIT = NXMED
      N1 = NINIT + NSTRIP*(K2-1) + 1
      N3 = N1 + NSTRIP
      GO TO 220
  200 IF (K1 .EQ. 2) GO TO 210
      N1 = MDIV(1) + 1
      N3 = NXMED
      IF(LANE(2) .EQ. 0) N3 = NX - MDIV(2)
      GO TO 220
  210 N1 = NXMED + 1
      N3 = NX - MDIV(2)
  220 SUM = 0.
      NN = NN + 1
      XMIN(NN) = 9999999.
      XMAX(NN) = -9999999.
      DO 350 K3=N1.N3
      FACTOR = 1.
      IF(K3.EQ.N1 .OR. K3.EQ.N3) FACTOR = 0.5
      DO 350 K4=1.NY
      FACT2 = FACTOR
      IF(K4.EQ.1 .OR. K4.EQ.NY) FACT2 = 0.5*FACT2
      IF(DATAS(K4.K3) .LT. XMIN(NN)) XMIN(NN) = DATAS(K4.K3)
      IF(DATAS(K4.K3) .GT. XMAX(NN)) XMAX(NN) = DATAS(K4.K3)
  350 SUM = SUM + DATAS(K4.K3)*FACT2
      AVG(NN) = SUM/((NY-1)*(N3-N1))
      IF(XMIN(NN) .EQ. 0.) GO TO 360
      AVGMIN(NN) = AVG(NN)/XMIN(NN)
      MAXMIN(NN) = XMAX(NN)/XMIN(NN)
      GO TO 370
  360 AVGMIN(NN) = 999999.
      MAXMIN(NN) = 999999.
  370 IF(AVG(NN) .EQ. 0.) GO TO 380
      MAXAVG(NN) = XMAX(NN)/AVG(NN)
      GO TU 390
  380 MAXAVG(NN) = 999999.
  390 N1 = N3
  345 CONTINUE
      N1 = N3 + 1
      N3 = N1
  300 CONTINUE
      RETURN
      END
```

D.9/ AVG1, AVG2, and AVCALC Subroutines Program Listing

The routine AVG1 determines the starting and ending position grid points to be summarized for the calculation of average luminance values. Having determined these limits, successive calls of AVCALC are made to calculate averages for individual lanes and the entire roadway.

The routine AVG2 is called to calculate the starting and ending positions of lanes for the averaging of illuminance values. This routine also calls up AVCALC for the determination of average values for individual lanes and the total roadway.

The AVCALC routine calculates uniformity ratios by measuring the illuminance and luminance values of each grid point for lanes, roadways and median sections.

```
      SUBROUTINE AVG1(DATAS,AVG,XMAX,XMIN,AVGMIN,MAXAVG,MAXMIN,NCHK)
C
C     THIS ROUTINE FINDS ILLUMINANCE,LUMINANCE CHARACTERISTICS
C     **************************************************************
C
      COMMON /ONE/  DISTP,      DVBANG(3),FMAIN(4), HT(4),      KDIV,
     1              LANE(2),    LUSTAT(4),MDIV(2),  NLK(4),     NLUA,
     2              NSTRIP,     OFFSET(4),PATERN,   PAVTYE,     GO,
     3              RDWAY(2),   REV,      TYPE(4),  UNIT,       USTAT(4),
     4              WMED,       LUCODE,   MANUF,    RADIUS,     ICURVE,
     5              C,          IRINDA(4),EPSLN,    UPHILL,     WLANE(2,4),
     6              WSHOLD(2),MEDIV,      RDWD(2)
C
      COMMON /TWO/  STAT(4),   X(46),   XLC(91,8),  XLU(26,4),XSTRIP(2),
     1              PAVE(4),   Y(91),   YLC(91,8),  YLU(26,4),ZLU(26,4),
     2              NC,        NLU(4), NX,          NXMED,    NY,
     3              DELTAX(91,46),      DELTAY(91,46),
     4              XSSTRP(2),XMSTRP, NLX,  NMX, XX(25)
C
      COMMON /CONST/DETORA, PI, HAFPI, PI10, HIORIV, FM90, ANGLIM,
     1              TYPNO, NMANU, NOPN, SILMP, TRACE
C
      LOGICAL       SILMP
      LOGICAL*1     TRACE(3)
C
      REAL DATAS(91,46), AVG(10), XMAX(10), XMIN(10), AVGMIN(10),
     1     MAXAVG(10), MAXMIN(10)
C*************************************************************************
C
C NCHK = 0 :  READ REFLECTANCE VALUES FROM FILE 10 AND FIND AVERAGE
C             LUMINANCE FOR ENTIRE SIDE OF ROADWAY
C
C NCHK = 2 :  READ REFLECTANCE VALUES FROM FILE 10 AND FIND AVERAGE
C             LUMINANCE FOR INDIVIDUAL LANES
C*************************************************************************
C
      NN = 0
      N1 = MDIV(1)/2 + 1
C
C *** DO LOOP BASED ON MAX. NO. OF ROADWAY.I.E. 2
      DO 300 K1=1,2
      IF(LANE(K1) .EQ. 0) GO TO 300
      N2 = LANE(K1)
C
C...FIND STARTING AND ENDING POINTS FOR REQUIRED "AVERAGE" CALCULATIONS
C
C *** DO LOOP BASED ON EACH DRIVER POSITION PER ROADWAY
      DO 345 K2=1,N2
      N3 = N1 + NSTRIP/2 - 1
      READ(10) DATAS
      IF(NCHK .EQ. 2) GO TO 220
      N1 = 1
      N3 = NXMED
      IF(K1 .EQ. 1) GOTO 220
      N1 = NXMED + 1
      IF(MEDIV .EQ. 2) N1 = N1 -1
      N3 = NX
C
 220  IF(.NOT. TRACE(1)) GOTO 250
      WRITE(6,900) NCHK
 900  FORMAT(//' ARRAY "DATAS"   X --> ,  Y(DOWN)',10X,'NCHK =',I5
     *       /1X,13('=')//)
      DO 225 I=1,NY
 225  WRITE(6,901) (DATAS(I,J),J=N1,N3)
 901  FORMAT(1X,11(F12.5))
C
C..."X-ARRAY" :  CONTAINS POINTS WHERE ILLUMINANCE & LUMINANCE
C                CALCULATIONS WERE MADE.
C..."XX-ARRAY":  CONTAINS POINTS OF BOUNDARIES OF THE STRIPS
C
C EXAMPLE:       |         |               |               |
C          X =>  |    *    |    *       *  |    *       *  |
C                |         |               |               |
C          XX => *         *       *       *       *       *
C                |         |               |               |
C                SHOULDER      LANE 1          LANE 2
C
 250  NN = NN + 1
      CALL AVCALC(DATAS,AVG,XMAX,XMIN,AVGMIN,MAXAVG,MAXMIN,NN,N1,N3,10,
     *            NCHK)
 390  N1 = N3 + 1
      IF(TRACE(1)) WRITE(6,902) NN,XMIN(NN),NN,XMAX(NN),NN,AVG(NN)
 902  FORMAT(/1X,'XMIN(',I2,') = ',F10.4,'  XMAX(',I2,') = ',F10.4,
     *       '  AVG(',I2,') = ',F10.4)
 345  CONTINUE
      N1 = NXMED + 1
C
 300  CONTINUE
      RETURN
      END
      SUBROUTINE AVG2(DATAS,AVG,XMAX,XMIN,AVGMIN,MAXAVG,MAXMIN,AVGS,
     *      XMAXS,XMINS,AVGMNS,MXAVGS,MXMINS,AVGM,XMAXM,XMINM,AVGMNM,
     *      MXAVGM,MXMINM)
C
C     THIS ROUTINE FINDS ILLUMINANCE,LUMINANCE CHARACTERISTICS
C
C     ************************************************************
C
      COMMON /ONE/  DISTP,      DVBANG(3),FMMIN(4), HT(4),      KDIV,
     1              LANE(2),    LUSTAT(4),MDIV(2),  NLR(4),     NLUA,
     2              NSTRIP,     OFFSET(4),PATERN,   PAVTYE,     QO,
     3              RDWAY(2),   REV,      TYPE(4),  UNIT,       USTAT(4),
     4              WMED,       LUCODE,   MANUF,    RADIUS,     ICURVE,
     5              C,          IRINDX(4),EPSLN,    UPHILL,     WLANE(2,4),
     6              WSHOLD(2),MEDIV,      RDWD(2)
C
      COMMON /TWO/  STAT(4),  X(46),    XLC(91,8),  XLU(26,4),XSTRIP(2),
     1              PAVE(4),  Y(91),    YLC(91,8),  YLU(26,4),ZLU(26,4),
     2              NC,       NLU(4), NX,           NXMED,    NY,
     3              DELTAX(91,46),      DELTAY(91,46),
     4              XSSTRP(2),XMSTRP, NLX,  NMX, XX(25)
C
C
      COMMON /CONST/DETORA, PI, HAFPI, PI10, HTDRIV, FM90, ANGLIM,
     1              TYPNO, NMANU, NOPN, SILMP, TRACE
C
      LOGICAL       SILMP
      LOGICAL*1     TRACE(3)
C
      REAL DATAS(91,46), AVG(10), XMAX(10), XMIN(10), AVGMIN(10),
     1     MAXAVG(10), MAXMIN(10),AVGS(2),XMAXS(2),XMINS(2),AVGMNS(2),
     2     MXAVGS(2),MXMINS(2),MXAVGM,MXMINM
C
      NN = 0
      N1 = 1
      N3 = MDIV(1)/2
C
      IF(MDIV(1) .EQ. 0) GOTO 100
      CALL AVCALC(DATAS,AVGS,XMAXS,XMINS,AVGMNS,MXAVGS,MXMINS,1,N1,N3,2,
     *     1)
  100 N2 = LANE(1)
      IF(N2 .EQ. 0) GOTO 250
C
      DO 200 I=1,N2
      NN = NN + 1
      N1 = N3 + 1
      N3 = N1 + NSTRIP/2 - 1
      CALL AVCALC(DATAS,AVG,XMAX,XMIN,AVGMIN,MAXAVG,MAXMIN,NN,N1,N3,10,
     *     1)
  200 CONTINUE
C
  250 IF(MEDIV .EQ. 0) GOTO 300
      N1 = NXMED
      N3 = N1 + NSTRIP/2 -1
      CALL AVCALC(DATAS,AVGM,XMAXM,XMINM,AVGMNM,MXAVGM,MXMINM,1,N1,N3,1,
     *     1)
C
  300 N2 = LANE(2)
      IF(N2 .EQ. 0) GOTO 450
      DO 400 I= 1,N2
      NN = NN + 1
      N1 = N3 + 1
      N3 = N1 + NSTRIP/2 - 1
      CALL AVCALC(DATAS,AVG,XMAX,XMIN,AVGMIN,MAXAVG,MAXMIN,NN,N1,N3,10,
     *     1)
  400 CONTINUE
C
  450 N1 = N3 + 1
      N3 = NX
      IF(MDIV(2) .EQ. 0) GOTO 500
      CALL AVCALC(DATAS,AVGS,XMAXS,XMINS,AVGMNS,MXAVGS,MXMINS,2,N1,N3,2,
     *     1)
  500 RETURN
      END
      SUBROUTINE AVCALC(DATAS,AVG,XMAX,XMIN,AVGMIN,MAXAVG,MAXMIN,NN,N1,
     *           N3,NDIM,NCHK)
C
C     THIS ROUTINE FINDS ILLUMINANCE,LUMINANCE CHARACTERISTICS
C
C     ******************************************************************
C
      COMMON /ONE/  DISTP,      OVHANG(3),FMAIN(4), HT(4),      KDIV,
     1              LANE(2),    LUSTAT(4),MDIV(2),  NLR(4),     NLUA,
     2              NSTRIP,     OFFSET(4),PATERN,   PAVTYE,     QO,
     3              RDWAY(2),   REV,      TYPE(4),  UNIT,       USTAT(4),
     4              WMED,       LUCODE,   MANUF,    RADIUS,     ICURVE,
     5              C,          IKINDX(4),EPSLN,    UPHILL,     WLANE(2,4),
     6              WSHOLD(2),MEDIV,      RDWD(2)
C
      COMMON /TWO/  STAT(4),   X(46),    XLC(91,8),  XLU(26,4),XSTRIP(2),
     1              PAVE(4),   Y(91),    YLC(91,8),  YLU(26,4),ZLU(26,4),
     2              NL,        NLU(4),   NX,         NXMED,    NY,
     3              DELTAX(91,46),       DELTAY(91,46),
     4              XSSTRP(2),XMSTRP,    NLX,   NMX, XX(25)
C
C
      COMMON /CONST/DETORA, PI, HAFPI, PI10, HTDRIV, FM90, ANGLIM,
     1              TYPNO, NMANU, NOPN, SILMP, TRACE
C
      LOGICAL         SILMP
      LOGICAL*1       TRACE(3)
C
      REAL DATAS(91,46),AVG(NDIM),XMAX(NDIM),XMIN(NDIM),AVGMIN(NDIM),
     1          MAXAVG(NDIM),MAXMIN(NDIM)
C
      TSUM = 0.
      XMIN(NN) = 9999999.
      XMAX(NN) = -9999999.
      DO 355 K3=N1,N3
      SUM = 0.
C
C..FACT2 = (STRIP WIDTH) / (TOTAL WIDTH)
C
      FACT2 = (XX(K3+1) - XX(K3)) / (XX(N3+1) - XX(N1))
C
C...TAKE ONLY HALF OF THE MEDIAN STRIP FOR AVERAGE ROADWAY CALCULATIONS
C
      IF(NCHK.EQ.0 .AND.(N1.EQ.NXMED .OR. N3.EQ.NXMED).AND. MEDIV.EQ.2)
     *       FACT2 = FACT2 * .5
      DO 350 K4=1,NY
      FACTOR = 1.
      IF(K4.EQ.1 .OR. K4.EQ.NY) FACTOR = 0.5
      IF(DATAS(K4,K3) .LT. XMIN(NN)) XMIN(NN) = DATAS(K4,K3)
      IF(DATAS(K4,K3) .GT. XMAX(NN)) XMAX(NN) = DATAS(K4,K3)
      SUM = SUM + DATAS(K4,K3)*FACTOR
  350 CONTINUE
      TSUM = TSUM + SUM*FACT2
  355 CONTINUE
C
C..CALCULATE AVERAGE AND FIND UNIFORMITY RATIOS
C
      AVG(NN) = TSUM/(NY-1)
      IF(XMIN(NN) .EQ. 0.) GO TO 360
      AVGMIN(NN) = AVG(NN)/XMIN(NN)
      MAXMIN(NN) = XMAX(NN)/XMIN(NN)
      GO TO 370
  360 AVGMIN(NN) = 999999.
      MAXMIN(NN) = 999999.
  370 IF(AVG(NN) .EQ. 0.) GO TO 380
      MAXAVG(NN) = XMAX(NN)/AVG(NN)
      GO TO 390
  380 MAXAVG(NN) = 999999.
  390 RETURN
      END
```